MATERIAL CULTURE OF KAPINGAMARANGI

BY

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Material Culture of Kapingamarangi

By TE RANGI HIROA (PETER H. BUCK)

INTRODUCTION

The Bishop Museum Expedition to Kapingamarangi formed part of the project which was termed the Coordinated Investigation of Micronesian Anthropology, more briefly referred to as CIMA. The project was organized by the Pacific Science Board, which was set up by the National Research Council as the result of a conference held in Washington in June 1946. The project was supported by the Navy both in field equipment and in funds, in order that studies of the manners and customs of the native inhabitants of Micronesia might become available as an aid to the civil administration of the Trust Territory of the Pacific Islands which was later entrusted to the United States by the United Nations. Twenty-three American universities and museums responded to the call for scientists, and 43 trained anthropologists and geographers were selected to visit the various island groups to do field work.

Bishop Museum chose Kapingamarangi for its field because it was generally known that the atoll was inhabited by people of Polynesian stock speaking a Polynesian dialect. The members of our party consisted of S. H. Elbert, to study language; K. P. Emory, to study social organization and religion; and me to work on material culture and physical anthropology. C. J. Lathrop accompanied the party as photographer and technician. We left Honolulu with research parties from the mainland on July 6, 1947 and were flown by Navy plane to Guam, where we were fitted out with field equipment from Navy stores. Our party, with those for the central and eastern Carolines, were flown by Navy plane to Truk, where we were supplied by the Navy with three months' provisions. We left Truk on July 12 on the LST 1091 and arrived at Kapingamarangi on July 15 after calling at the Mortlock Islands.

Kapingamarangi lies south of Truk and is less than two degrees north of the equator. It is a typical atoll with 33 islets perched on the reef, which surrounds a central lagoon (fig. 1). A fairly deep passage on the south admits ships of the LST class. The most populated island is Touhou, and the neighboring island of Werua supports most of the remaining population, which totals 519.

Our party was housed at Touhou in two timber-built houses owned by David, the late leading chief of the atoll and usually alluded to as King David. It is with deep regret that I learn of his death, on December 10, 1949, on Kapingamarangi. He was a good administrator and a fine leader, and his death will be a great loss to his people. The officials of the Trust Territory of the Pacific will miss his whole-hearted cooperation.

The people, friendly and hospitable, are taller and more robust than the Micronesians. Their skin color is the typical Polynesian brown and their hair is wavy or curly. No trace is seen of the woolly hair of the negroids or the inner eyefold of the mongoloids. Both men and women are healthy and hardworking.

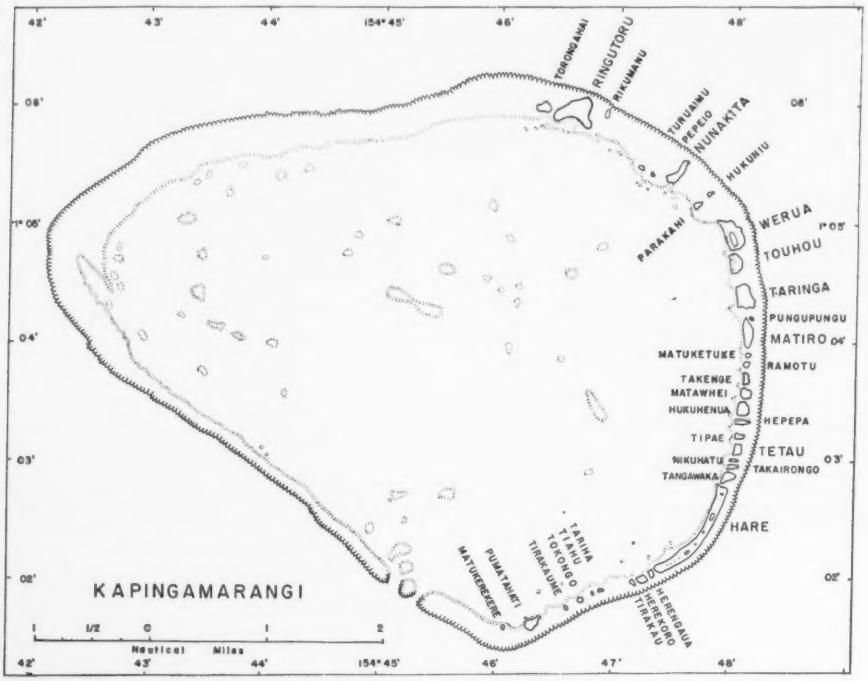

FIGURE 1.—Map of Kapingamarangi.

I took physical measurements of 70 males, but pressure of other studies prevented me from measuring a representative number of females. The males measured were checked by K. P. Emory against his genealogical records, and 59 were found to have no intermixture with Europeans or other islanders. A few average measurements of the 59 males show a close affinity with similar averages for Marquesans and New Zealand Maoris.

	KAPINGAMARANGI	MARQUESAS	MAORI
Height	1723 mm.	1703 mm.	1706 mm.
Head length	195.4	193.2	196.5
Head width	152.6	153.2	152.8
Cephalic index	77.79	79.40	77.70

Photographs of some of the people are shown in figures 2-4.

FIGURE 2.—Tiatu.

The language is a pure Polynesian dialect with few, if any, intrusions from Micronesia. However, though three of us had a speaking knowledge of other Polynesian dialects, it took some time before we could converse freely in the local language. Minor changes are present, such as the frequent use of the vowel *o* for the *a* of other dialects. The usual definite article, *te,* is *ti* and the plural, instead of *nga,* is *na* or *nia.* The names of some things are slightly different in the singular and the plural. However, our knowledge of other dialects helped materially, for there is much that is common. We mastered the language sufficiently to conduct our inquiries without the aid of an interpreter.

FIGURE 3.—*a,* King David; *b,* Ruta, daughter of a previous king, Tawehi.

To a museum worker who has often had to dissect museum specimens in order to unravel the technique of forgotten crafts, the functioning culture of Kapingamarangi is refreshing and stimulating. We could watch things being made for use and we were able to make pictorial records in stills and movies of crafts which were essential to the life of the people. Even crafts which had been abandoned were resurrected by the old men who had employed them in the days of their youth. Various craftsmen demonstrated old techniques and made illustrative specimens to provide a comprehensive collection so that Kapingamarangi might be worthily represented with the other Polynesian islands in the collections of Bishop Museum.

FIGURE 4.—Ti Rongorongo in mat skirt.

In the following work, I endeavor to record in detail the various technical processes still functioning in Kapingamarangi, and some of the abandoned ones, such as the manufacture of bark cloth from breadfruit bast. We were fortunate in getting full details of weaving, from the preparation of the thread to the weaving of the textile. The plaiting of articles from coconut leaf and pandanus leaf is fully described and is illustrated to establish material for comparative study with other areas. Food, houses, canoes, and fishing are gone into with as much detail as could be acquired in the time available. The

study in the field occupied two and one half months, for I landed in Kapingamarangi on July 16, 1947 and left on September 26.

The details of technical processes cannot be adequately reported unless they are illustrated by diagrams of the various stages. With this in view, about 150 line drawings were made to illustrate this work. The drawings of technical details were made by me, but I am indebted to Amy Suehiro for the drawings of artifacts.

ACKNOWLEDGMENTS

The success of the CIMA project is largely due to the whole-hearted support of the United States Navy, as those of us who have been on anthropological expeditions to other parts of the Pacific realize. Formerly, much time and expense were involved in reaching and returning from islands remote from established routes and making connections with trading schooners which had no regular time table. For the first time in scientific research, the matter of transport received primary attention from an organization which could provide airplanes and ships to take investigators directly to their fields of operation. And the providing of field equipment and provisions by the Navy not only saved considerable expense but allowed scientists to devote their full time to their respective studies. Our sincere thanks are tendered to the United States Navy, and I wish to make special acknowledgment to Admiral Wright, Deputy Commissioner of the Trust Territory of the Pacific Islands, and his staff. At Guam, we received every assistance from Commander Duke; at Truk, from Commander Huxley.

I wish also to acknowledge the assistance we received from the native inhabitants in the field, especially King David, Alfred Patterson, Hetata, Rimari, Tomoki, Mairiku, Tawhera, and the women who demonstrated their crafts. And I owe my thanks to my colleagues, K. P. Emory, S. H. Elbert, and C. J. Lathrop, for we were of common assistance to one another where our studies overlapped.

Lastly, acknowledgment is made to members of the staff of Bishop Museum who helped in the compiling and typing of this manuscript.

FOOD

INTRODUCTION

The vegetable foods of an atoll are few in number, owing to the nature of the soil and the insufficient water supply. However, the coconut and pandanus thrive and their fruit furnishes the inhabitants with a goodly supply of food. In addition to these, the *puraka* (*Cyrtosperma chamissonis*) may be cultivated by excavating the upper layers of coral sand and digging down to subsoil water to make sunken gardens. In Polynesia, the *puraka* did not get beyond Raka-

hanga in the northern Cook group; but on some of the Tuamotu atolls farther east, taro was grown in sunken trenches. In some Polynesian atolls, the fruit of the *noni* (*Morinda citrifolia*) was eaten and purslane or pigweed (*Portulaca oleracea*) furnished a green vegetable.

In Kapingamarangi, in the Carolines, nature has been more generous. Taro was grown in the sunken gardens before the introduction of *puraka*, the coconut grows profusely on all the islands, and fruit-bearing pandanus trees are plentiful. An important addition is the breadfruit, which grows to a large size and bears abundant fruit. Bananas are also grown among the *puraka* in the cultivations. By combining coconut with taro, *puraka*, and breadfruit and cooking in different ways, a number of preparations are made which add variety to the diet.

Fish provide the main protein food, but in recent times, pigs and fowls have been introduced to add to the food supply. Thus food is plentiful, and during our stay, various families kept us supplied with more cooked food and fresh fish than we could consume. This is Polynesian hospitality which is extended as a matter of course to visitors, who are treated as guests of the community. The people themselves are healthy and well-nourished, and we saw no signs of malnutrition or rickets. It is evident that the native food supplies are ample and that the people have a well-balanced diet.

COOKING

Fire-making

As matches have long been in use, we were surprised to get demonstrations of fire-making from young people. A member of our party, visiting the outer islands and studying the reef on the way, got his matches wet and tried in vain to light a cigarette. A local youth, seeing his plight, quickly rubbed two sticks together and smilingly offered him a light. The method is so well known and so unhesitatingly produced that it is probably still functioning at times in the cultivations when matches do not happen to be available.

The method follows what has been termed the Polynesian plough method with a stationary understick on the ground and a pointed upper stick which is rubbed along a groove formed on the understick. The movements are slow until the groove is defined and deepened to pile up wood dust at the far end of the groove. Then the forward and backward movements quicken and the friction creates heat which causes the dust to smoulder and smoke. The understick is turned over on some dry coconut husk or dry leaf stipule and tapped on the back to free all the lighted dust. The husk or stipule is waved to-and-fro to form a draft, and the dry material kindles into a flame.

The process of making fire (*ahi*) with fire sticks is termed *koro*; *e koro ti ahi* (to produce fire). When the wood dust smokes, it is termed *kita*, and when

the coconut husk catches fire, it is termed *ka*. No specific terms are remembered for the two fire sticks. The lower one is simply described as *ti rakau koro ahi* (the wood producing fire), the upper one as *ti rakau e hai i nua* (the stick that works above).

Fuel

The economic timber supply of the atoll would be seriously depleted if it were used for firewood, but nature has provided ample substitutes from what would otherwise be waste materials to cumber the ground and increase the work of keeping occupied places tidy. These materials are the husks (*puru*) from both green and mature coconuts, the old coconut shells (*ipu*), the dry flower sheaths (*taume*) and dry racemes (*ti anga kororo*) of coconuts, and the chewed keys (*pinu*) of pandanus fruit. The husk segments are stored usually in outer houses, where the green husks dry, or in one end of the canoe house, or even in the cooking house. When I first saw segments of coconut husk piled up in an outer house. I thought it was merely part of an organized plan to keep the village clean, but after seeing the large quantities of husk used in the cooking fires, I soon realized that the people made wise provision for their daily needs in keeping each day's husks. Even in the outer islands, sheds and kitchens are well-stocked with husk segments to provide fuel for those who stay over to work in their cultivations or to fish.

Dry coconut shells (*ipu*) are abundant, for many mature nuts are used to produce the coconut cream which is so important to food preparations. Dry shells burn with a strong clear flame said to be good for cooking fish, and I have seen fires built entirely of coconut shells.

The flower sheaths and racemes are perfectly dry when they fall from the coconut trees. Though not available in quantity, they still form accessory fuel.

The ripe keys of pandanus fruit after being chewed, share in the conversion of rubbish into a useful fuel.

Available dry branches of wood are used for fuel when not needed for other purposes. The best wood is *pua* (*Guettarda speciosa*). The branches are broken into short lengths of a couple of feet or so and tied in a bundle for transport to the home. Such fuel is termed *tohumu*, one of the many words which differ in the singular and plural. The singular with the singular article *ti* is *ti motohumu*, the plural with the article *nia* is *nia tohumu*. Also, the chips of breadfruit wood from shaping the hull of a canoe are gathered up in baskets and taken home for the cooking fire.

Open-Fire Cooking

Cooking on the open embers or on heated stones without covering is termed *tunu*, as it is throughout Polynesia. The open fire is used in the outer islands for a scratch meal, as it saves time and labor, and by fishing parties who make

a snack by grilling some of their catch. In the home, the open fire is used in cooking breadfruit as an alternative to preparations which take more time. The skin is lightly scraped with a *tuouwe* (*Cardium orbita*) shell and a girl of the family may be seen squatting beside the slow fire of heated stones turning the fruit from time to time to prevent scorching. Some things, such as a fowl, may be cooked on the heated stones of an oven before the stones are leveled off for the oven cooking. It may be partly cooked in this way and then wrapped up in breadfruit leaves to finish cooking with the other foods placed in the oven.

The Earth Oven

The earth oven (*imu*) on an atoll with limited wood and no basaltic stone illustrates interestingly how people can adjust their culture to their environment and develop a perfect balance. The various stages are the same as on the high islands, but the use of local material shows adaptation and deserves a detailed report.

The oven, located at one end of the family cooking house (*hare imu*), is a shallow depression scooped out in the sandy floor with half coconut shells. The circular edge of the depression is not permanently defined with coral slabs, but is shaped anew and cleared before each cooking. When a larger oven is needed, for larger quantities of food for a working party, for instance, the oven is usually made in the open. In one I observed, to provide food for a party engaged in thatching a house, a large depression over a foot deep was scooped out with a shovel and the circumference defined with the shovel.

In building the fire, dry husk segments were scattered over the floor of the oven. A lighted coconut husk was used to commence the fire. The light was obtained by friction with fire sticks, as a demonstration for the Museum party. As this oven was large, women brought in more lighted husk segments from another fire and five different starting places were spaced over the bottom of the oven. Dry husk fibers, loosened by tearing with the fingers, were added to the starting points to get the fires well-established. One woman kept throwing husk segments out of the nearby canoe shed, while two others stacked them methodically around and over the lighted centers until the whole floor of the depression was covered. Some large pieces of unused coral were stacked in at intervals on the edge. More and more husks were added with the open, fibrous parts on the under side so as to kindle more rapidly. The circumference was carefully defined with husks and the fuel built up to quite a mound above the surrounding ground. The number of husk segments used in building up this large oven was surprisingly large and represented a goodly number of nuts. Finally, flames began to rise through the smoke from the bottom, breaking through spaces between the segments.

When the fire had spread to all parts, the layer of stones was added. The oven stones (*nia hatu imu*), consisting of fresh pieces of coral of medium size, were arranged methodically over the arched mound of fuel. Smaller stones which had not crumbled from previous use were scooped up with the hands and distributed so as to complete the layer over the fuel. When the fuel burned down, the stones were sufficiently heated to cook any food. This stage is termed *wate* and the phrase used is *ku wate ti imu* (the oven is heated).

The stones scooped up must not be too small (*turi*), lest they filter through and the fire be put out (*e mate ti ahi*). When the pieces of coral crumble to smaller size or to dust through repeated cooking, baskets of clean coral stones are brought back from the outer islands from time to time to replenish the stock. Coral is brought from other islands because the coral around the inhabited islands may be contaminated.

The next step, leveling out the heated stones, is termed *uru* as *ka uru ti imu* (the oven is leveled). Both the process and the term *uru* are widely spread in Polynesia. The leveling is done with any stick, which is also used to toss out unburnt husks that might smoke. The stones are spread evenly with a slight depression in the center and covered with green material to prevent the food from scorching through direct contact with the hot stones. The covering is usually extra green breadfruit leaves and banana leaves provided as wrappings for some of the food preparations. However, other green or moist material is used as a carpet (*hariki*) over the hot stones. For instance, I noticed that *puraka* peelings were placed in a basket, as I thought for disposal as garbage, but the basket appeared beside the oven and the peelings were added to the leaf carpet. Also, when breadfruit is used in quantity, the cores are placed in a basket and saved for stone covering.

The food, consisting mainly of preparations in leaf wrappings or in coconut-shell casseroles which will be described later, is now placed in position. In the oven which we saw prepared, the food was covered and sealed to keep in the heat. Left-over breadfruit leaves, sections of banana leaf, and *puraka* leaves were spread over the food before the mats were applied. Special coconut-leaf mats termed *tanga imu* were prepared for this purpose, but I noticed that portions of old pandanus mats were also used. The mats were spread to overlap and completely cover the mound of food. This was necessary to keep sand or dirt out, for the final step consisted of "burying (*tanu*) with earth" (*ka tanu ki ni kerekere*). Earth or sand which had been used before was around the oven site and quickly scraped up over the mat covers with half coconut shells. The earth was evenly distributed to completely bury the mound, and the oven was left to cook. (See figure 5.)

The local term for cooking in an earth oven is *ta*, in distinction from the open cooking termed *tunu*. The term *ta* is an abbreviation of the Polynesian

term *tao* and is expressed in the phrase *ka ta ti imu* (the oven is cooking). The food is cooked (*mo*) in about two hours.

The process of uncovering the oven is termed *huke,* also a widely spread Polynesian term. In cooking, it is the oven which is referred to and not the food as "ku mo ti imu, ka huke" (the oven is cooked, uncover).

FIGURE 5.—Covering earth oven.

We watched while the earth was carefully removed with half coconut shells. Then two women grasped the ends of a mat and carefully removed it so that no remaining earth would fall on the oven. After the mats, the covering leaves were removed and the food in the still steaming oven exposed. The uncovered coconut-shell casseroles showed that the coconut cream had boiled up to the surface, but the casseroles with covers showed no external change. The leaf packages were moist, and the green leaves had changed color in the cooking. Some whole breadfruits which had been arranged around the edge were picked up and placed in a basket. The leaf packages followed, but the casseroles were too hot to handle with the bare hands. Thus ended the sequence of operations from the fire sticks to the cooked food.

COOKING ACCESSORIES AND UTENSILS

In preparing food for cooking, a number of accessories are required, from leaves to wooden bowls. Some special instruments, such as graters, are described with the section on coconuts.

Leaves are used to wrap (*hi*) certain foods for consignment to the oven, and leaf packages for the *hakaroi* preparations are in everyday use. Those

most in use are of breadfruit, *puraka*, and banana, but hau leaves are used with some of the grated preparations. Breadfruit leaves are readily procurable from the breadfruit trees which grow near the houses, and a quantity of *puraka* leaves is always brought in from the cultivations together with the supply of *puraka* tubers for cooking. Banana leaves are preferred for the inner wrapping and when so used they are termed *ti rau me*. Green pandanus leaves are used for wrapping larger parcels of fish. Breadfruit, *puraka*, and banana leaves are usually combined in layers to form the leaf packages. For smaller objects, such as a *puraka* tuber, a single *puraka* leaf may be used as wrapping; for single breadfruit, such as the *kuru para* preparation, breadfruit leaves alone are used. The more elaborate leaf packages require a plaited receptacle of green coconut leaf to support them. Strips of hau bast, green coconut leaflets, and pandanus leaves are used for tying the leaf coverings in place.

Plaited receptacles of green coconut leaf to support the leaf packages are termed *poroporo* and receive distinguishing terms according to their size and the kind of food preparation. Small, round, deep receptacles are termed *poroporo hakaroi*, as they are made for the leaf packages of the *hakaroi* preparation. Flat platters, termed *poroporo hiki*, are made for longer packages of food such as *tuahu* preparations and for fish, and still longer ones for the grated food preparation termed *toro*.

Both green and mature coconut shells form natural casseroles for cooking. Shells of the green nuts, in which the soft flesh is grated with a hand grater, are used for cooking *hakate* preparations, and mature shells are used for *putara* preparations, to which coconut cream is added.

Marine shells are used on occasion for scraping, peeling, and grating, particularly in the outer islands, though formerly they were used to a much greater extent. The shells commonly used are the *tuouwe* (*Cardium orbita*), *kocho* (*Barbatia candida*), and *pipi* (*Asaphis violacea*). The *tuouwe* functions as a hand grater and as the grating edge of stand graters. It is also used as a scraper for breadfruit. Both the *kocho* and *pipi* are used in peeling taro. The use of these shells raises the question of the differences in the method of scraping, peeling, and grating.

Scraping is the process of abrading and removing the skin by drawing the hard edge of a shell over the surface. In Polynesia, the process is termed *waru* and is applied to both breadfruit and taro. In Kapingamarangi, however, the process of light scraping is termed *pepe* and is applied to breadfruit alone, whereas the term *waru* is confined to the process of grating. Large shells are usually chosen and part of the curved edge is cracked off to form a straight, sharp edge. The shell is held with the fingers on the inner surface and with the thumb on the outer surface so as to make backhand strokes away from the operator.

Informants state that taro and *puraka* are peeled, never scraped. Peeling, or cutting through the skin with a sharp edge and removing the whole thickness of the skin in strips, is a more wasteful process than scraping. The local verb to peel (*uhe*) is applied to taro. The instrument formerly used was the pearl-shell *taku* used in trimming off the leaves of taro in the cultivations. Other instruments were shells of the *kocho* and the *pipi*, both of which have sharp, straight edges on one side. The shells were held with the thumb on the outer surface and the forefinger and fourth finger on the inner surface, which was uppermost. The long middle finger reached beyond the edge of the shell and rested on the taro. The hand pushed the cutting edge forward, and the middle finger aided in drawing the shell toward it. The skin was peeled off in short strips by movements away from the body. *Puraka* was introduced at a period when trade knives had been acquired and the metal knife (*turumanu*) had superseded the old shell peelers.

Grating, locally termed *waru*, reduces the food itself to small particles by rubbing against a rough edge or a rough surface. A rough edge attached to a stand is used for grating mature coconuts, whereas green nuts are grated with a hand grater formed of a *tuouwe* shell with a natural serrated edge or with a modern instrument made of metal. *Puraka* is grated against a rough surface, formerly a block of a certain kind of coral. Now a modern implement made of perforated tin is used. The grating implements are described fully under the headings of coconuts and of *puraka*.

WOODEN BOWLS

Wooden bowls are in everyday use in all families. A few articles of crockery and tin have come into use as receptacles, but they are not suitable for preparing native foods for which pounders are used. Hence new bowls are being made as old bowls become cracked or otherwise damaged. Damaged bowls are used as pig troughs, and I was tempted to rob the pig stys in collecting material for the Museum.

The general Polynesian name of *kumete* is retained but is sometimes pronounced *kumate* or even *kumat*. They are usually made of *pua* wood; and though they differ in size for various requirements, they conform to the same pattern. The rim opening is acutely elliptical, coming to a sharp point at each end. The bowls are deep in proportion to their size, and the curved sides meet in a sharp edge at each end and slope sharply down to form a small elliptical, flat bottom, corresponding in shape with the rim opening. Small handles (*kau*) with squared ends project horizontally outward from the two ends of the rim, or there may be one handle, or none. The handles are more for ornament than use, as the bowls are usually lifted without them. The cavity is rounded at the ends and at the bottom. Though elliptical bowls with end handles are

present in Samoa, the depth of the Kapingamarangi bowls with the end edges on the outside, the relatively small bottom externally, and the rounded interior, form a combination of local development (fig. 6). They are distinct from the Nukuoro bowls, which have circular rim openings and, though they have similar end handles, comparatively much less depth.

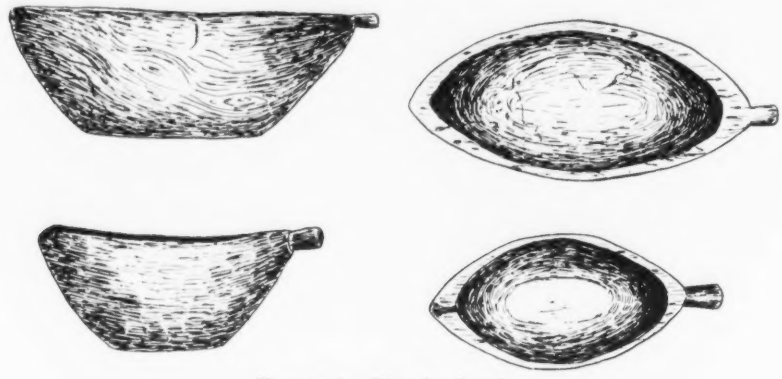

FIGURE 6.—Wooden bowls.

The following terms for the parts of a bowl are given by Eilers (2, p. 123)[1]. The spellings are corrected in the third column and the definite article, *ti* (the), retained.

PART	EILERS	CORRECTED
Bowl	ti kumat	ti kumate
Side	ti pae	ti pahi
Arch below handle	ti evi	ti iwi (sharp edge)
Inside bottom	ti loto	ti roto (or ti tono)
Outside bottom	ti touk	ti tua
Brim	talinga	ti taringa
Handle	ti ken	ti kau (ti kenu = new term)

A classification of bowls, based on use, was given to me as follows: (1) *kumete tau roro,* for straining (*tau*) coconut cream (*roro*); (2) *kumete tuki hokooto,* for pounding (*tuki*) breadfruit for the *hokooto* preparation (small and sufficient for about four persons); (3) *kumete piapia,* for kneading (*noku*) ripe breadfruit for serving the raw *piapia* preparation. Small bowls were used for pounding leaves or bark to be used as medicine.

The above classification merely serves to show how any bowl could be named from its use; the same bowl might have different names at different times, according to its use.

FOOD POUNDERS

Food pounders are usually termed *tuki* or *tukituki* from the verb *tuki,* to pound. An informant stated that to distinguish the food pounder from that

[1] Numbers in parentheses refer to Literature Cited, page 286.

used for beating pandanus leaves, breadfruit bast, and coconut husk, qualifying terms should be used. For example, in *tuki hokooto* or, in full, *tukituki tuki hokooto*, *tukituki* is the noun, *tuki* the verb, and *hokooto* the food preparation being pounded. As *hokooto* is only one food among many which are pounded, it would appear that other combinations of *tukituki* would have to be used.

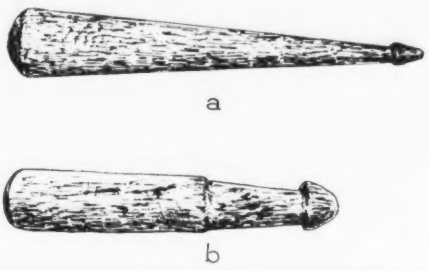

FIGURE 7.—Food pounders: *a*, Kapingamarangi; *b*, Nukuoro.

Food pounders are usually made of coconut wood and are long and heavy. One given to Bishop Museum (C.10036) is 27 inches long. The upper end has two knobs, the lower one being 1.5 inches in diameter, whereas the narrower neck of the shaft at the junction is 1.1 inches in diameter. The two knobs are separated by a shallow, transverse groove, and the end knob is trimmed to a point at the free end. The shaft and lower end are not quite circular, the cross diameters of the convex pounding surface being 3.9 inches by 3.1 inches (fig. 7, *a*). The lengths of the pounders vary with the depths of the bowls with which they are used. And the comparatively small pounding end is influenced by the small, rounded bottom of the cavity of the bowl. A Nukuoro pounder (C.10104) is shown in figure 7, *b* for comparison. It is 15 inches long and the circular pounding surface is 2.75 inches in diameter.

COCONUT-SHELL WATER CONTAINERS

Whole coconut shells were formerly used as water containers (fig. 8, *c*); and when so used, they were termed *ti wai* (the water). According to King David, the flesh was removed from inside the mature nut with a scoop and a small picker, of which he made specimens for the Museum.

The scoop (C.10033) termed *korokoro koro wai* consists of a handle of coconut wood, 22 inches long and 0.5 inch thick. One end is shaped to a convex chisel edge, and a curved piece of shell is lashed to the other, with close turns of a fine cord in half-hitches. The curved piece of shell is 0.7 inch wide with a convex edge at the free end. (See figure 8, *a*.) A hole is made in the nut through the eye, and the tool inserted to loosen and dig out the hard flesh.

The picker, *pou* (C.10034), is a diminutive form of the breadfruit picker. The handle is 13 inches long with an oblique piece one inch long lashed to one

end (fig. 8, *b*). The implement is inserted to drag out pieces freed by the scoop.

When I told King David that Samoans removed the flesh by the more simple method of filling the nut with sea water and allowing the flesh to rot and liquefy, he said that such a method was never used in Kapingamarangi. Hence, the implements described are a curious local invention.

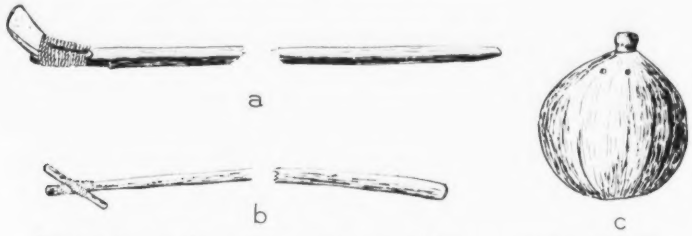

FIGURE 8.—Implements: *a*, scoop; *b*, picker; *c*, water container.

COCONUT-SHELL CUPS

Cups are not needed, as the fluid from drinking nuts is drunk from the nut and water can be drunk from the whole nut container. Neither is there kava or other fluid that requires serving in a cup. And the cups needed for pouring coconut cream into the food preparations are readily available from the half shells from which the flesh had been grated in preparing coconut cream. Old half shells are also used in the kitchen to spread and to remove the earth cover of the ovens. The only form kept is the mature shell used as a casserole in the *putara* food preparations. After use, these are usually hung up to dry, on the short ends of a many-branched stake driven into the ground near the dwelling house (fig. 9).

VEGETABLE FOODS

The principal vegetable foods are the coconut, breadfruit, taro, and *puraka*. Coconuts in the forms of grated green nut, coconut cream, and grated mature nut are used with breadfruit, taro, and *puraka* and similar methods are used in some of the preparations. The general name for prepared foods is *takangutu*, but specific names are applied to the methods. These, in turn, are distinguished by the name of the food so prepared. The methods applying in common are *hakaroi*, *hakate*, *putara*, and *hokooto*.

Hakaroi preparations are cooked in leaf packages with the addition of coconut cream. Leaves of breadfruit, *puraka*, and banana are arranged as a receptacle on a green coconut-leaf platter (*poroporo hakaroi*). In lining the *poroporo*, the breadfruit leaves are arranged first with their stalks down, sections of *puraka* leaves come next, and the inner layer is formed of sections of banana leaf. Pieces of breadfruit, *puraka*, or taro are placed in the leaf recep-

tacle, leaving enough leaf to fold over the food. Freshly prepared coconut cream is poured in until it is seen rising toward the upper level of the food. The tips of the leaves are folded over from the sides and the ends, and the leaf package with the *poroporo* platter under it is tied with a green coconut leaflet. The usual way of tying is to twist the two ends together and shove the twist under the band formed by the leaflet. The process of wrapping in leaves is termed *hi* as in the phrase, *ka hi ti puraka ki nia rau* (wrap the *puraka* in the leaves). The preparation cooked or uncooked is *hakaroi* and the various kinds are *hakaroi kuru, hakaroi puraka,* and *hakaroi taro.* When the tie is unfastened and the coconut-leaf receptacle removed, the opened-out leaves serve as a dish from which to eat.

FIGURE 9.—Coconut shell casseroles drying.

The three *hakate* preparations consist of pieces of breadfruit, *puraka,* or taro packed in a green coconut shell, the soft flesh of which has been grated with a hand grater to a fine creamy consistence. The stalk end of the green nut is cracked around and removed. This piece with the eye is termed *ti mata hakate.* The flesh around the upper edge of the main shell is removed as it is likely to come off in lumps and spoil the creamy consistence desired. All but a small amount of fluid is poured out. When the fine grating with a handgrater is finished, the food pieces are carefully packed (*hakatau*) in the shell with the grated material. Some of the fluid may be poured back until it rises to a short distance below the rim. The top part of the shell is replaced as a cover

and the coconut-shell container acts as a natural casserole when placed in the oven. The *hakate* preparations are distinguished by their composition as *hakate kuru, hakate puraka,* and *hakate tara* (taro). In the *putara* preparations, the sliced food is cooked in an uncovered mature coconut shell with coconut cream added. The shells acquire a very dark color from repeated cookings. Used with taro, the shells (*ipu*) are termed *ti ipu tara,* and so with *puraka* and breadfruit. Though no shell cover is used, the *tara* preparation has a piece of taro leaf over the opening, the *puraka* preparation, a piece of *puraka* leaf as a cover. The cooked preparation is termed *putara* and qualified according to the ingredient, as *putara kuru, putara puraka,* and *putara tara.*

Hokooto preparations are made with breadfruit, *puraka,* and taro. (With the present tendency to use *s* instead of *h,* the term *hokooto* is usually pronounced as *sokoto.*) The food is cut into small pieces, wrapped in leaves, and cooked in the oven, then pounded in a bowl and ground (*unuki*) with the beater until soft (*para*). The difference between pounding (*tuki*) and grinding or rubbing (*unuki*) is that in pounding, direct downward blows are used, whereas the *unuki* process consists of rubbing the material with the beater against the bottom of the bowl. This is a finishing process to eliminate small lumps. Grated mature coconut flesh (*kaniu waruwaru*) is then added and thoroughly mixed, when it is ready to serve. The general term *hokooto* is qualified by the particular food used: *hokooto kuru, hokooto puraka,* and *hokooto tara.*

A number of other individual preparations will be described with the specific foods.

Coconut

The Kapingamarangi name of the coconut plant is *niu,* which is used throughout Polynesia. The local names of the various parts of the plant are given in the legend with figure 10, *a, b*; the parts of the flower and fruit with figure 10, *c, d*; and the parts of the growing nut with figure 10, *e.*

The various stages in the development of the nut and their uses are listed below:

Matari: small, no use
Mataniu: larger size with edible husk at stalk end
Rumata: drinking stage, flesh soft
Rumata parapara: flesh, fluid
Motomoto: flesh, fluid not used for drinking
Kahatea: flesh
Hariu: flesh
Matu: mature nut, brown husk, thick hard flesh; for grating and copra
Upu: sprouting nut; spongy material fills cavity. Eaten raw or cooked. The leafy sprout is termed *homo.*

The two important stages are *rumata* and *matu.*

In the field, the coconut supplies both meat and drink. Thus, people going to the outlying islands to their cultivations need not take food with them. When they feel thirsty, one climbs a coconut tree and throws down some nuts in the drinking, or *rumata*, stage. Formerly these were quickly husked, and a few sharp taps around the pointed end cracked the shell, leaving a removable cap. Now, the large bush knife that is always carried to the outer islands makes husking unnecessary. The husk is readily sliced off at the far end with blows of the knife and the soft shell prized off to make an opening for drinking. One nut provides enough liquid to quench the average thirst. The husk surrounding the shell acts as a thermos flask, keeping the clear fluid cool.

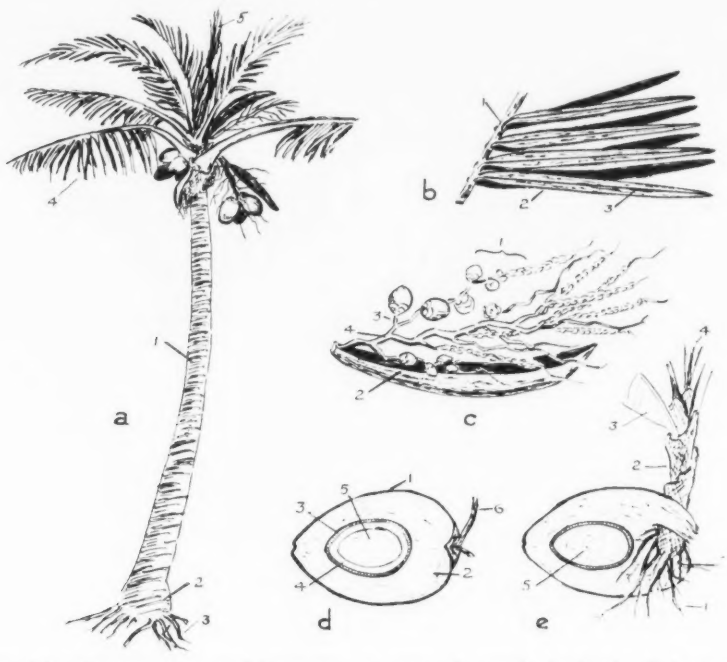

FIGURE 10.—Coconut tree and its parts. *a*, tree: 1, trunk (*rakau*); 2, base of trunk (*tona*); 3, roots (*aka*); 4, leaf (*rou niu*); 5, center leaves (*tira*). *b*, leaf parts: 1, midrib (*takai niu*); 2, leaflet (*mata rou niu*); 3, leaflet midrib (*tuaniu*). *c*, flower parts: 1, whole flower (*karoro*); 2, flower sheath (*taume*); 3, stalk of nut (*pa karihi*); 4, stalk of bunch (*kauroro*). *d*, mature fruit: 1, outer skin (*kiri taha*); 2, husk (*puru*); 3, shell (*ipu*); 4, flesh (*kaniu*); 5, fluid (*nia wai*, plural); 6, nut stalk (*pa karihi*). *e*, growing nut (*homo*): 1, roots (*aka*); 2, leaf stipule (*kaka*); 3, leaf (*rou homo*); 4, central leaf (*tira homo*); 5, spongy interior (*upu*).

Emptied of its fluid, the shell is split open and the soft coconut meat lining scooped out (*e tani*) with the fingers to allay hunger. Or, with the bush knife, a piece of the green husk can be sliced off to form a rough spoon to scrape out the meat.

If more food is required, there are always mature nuts of the *matu* stage lying about below the trees. Formerly these were husked, cracked around the middle into halves, and the thick, firm flesh scooped out with a marine shell. With the bush knife, the husk and shell are readily split into halves. The fluid in mature nuts is allowed to escape, as it contains oil which acts as a purgative and causes griping.

Coconut meat is termed *kaniu*, and the distinction between soft meat and hard meat is made by naming the stage of the nut: *kaniu rumata* and *kaniu matu*. The hard meat is regarded as the right complement (*kitaki*) with fish, and fishermen often stop at the outer islands to make a meal of grilled fish and *kaniu matu* before making the long beat back to the home islands of Touhou or Werua.

Sprouting nuts (*upu*) are also used for food in the field or at home. They are husked and split open or simply cracked into two with the bush knife. The white, spongy material (also termed *upu*) is delicious. In Kapingamarangi, it is sweeter and contains more juice than that I had in Tongareva, where it is called *uto*. Too much raw *upu* acts as a purgative, but cooking removes the purgative properties and one can eat several helpings with impunity.

CLIMBING LOOP

A climbing loop, often referred to as climbing bandage, is generally used to scale coconut trees, but many people climb the trees without one. In tree climbing without the loop, the sides of the trunk are gripped, so to speak, with the soles of the feet, the arms are raised to grip the trunk, and the body is drawn up with the knees bent to take another foothold higher up. In this way, the climber practically walks up the tree with the aid of his hands.

FIGURE 11.—*a*, *b*, climbing loop fixation.

The climbing loop (*kahanga*) is usually a coil of a two-ply coir cord, generally of the coarser kind made with a left-hand twist. One I observed in use, with four rounds of cord which made a stretch of about 16 inches, was made as follows (fig. 11, *a*, *b*).

Where the two ends overlapped, one end (*a*, 1) was wrapped three times around the coil including the second end (*a*, 2); the second end was doubled back over the turns, the wrapping end took another turn (*b*, 3) around the coil including the doubled-back end, and finished with an overhand knot (*b*, 4) on itself with a loop.

Loops are made of hau bark or breadfruit bark, if the climber has no two-ply cord at hand.

In using the loop, the climber passes the coil around both feet keeping them apart to hold the loop taut. He grasps the tree trunk with upstretched hands, draws his body upward with bent knees, and presses the taut loop against the tree trunk. Coconut trees have rough rings made by the leaves in successive years, and the coil holds against the rough bark. The climber, with a firm hold for his feet, straightens his knees and grasps the trunk higher up with his hands. He repeats the movements until he reaches the top.

He grasps a nut by the free end and twists it to break the stalk. Holding the nut by the same end, he gives it a twist as he lets go. The twist gives the nut a spin and it lands on its pointed end which prevents it from splitting and wasting the drinking fluid. For mature nuts, the spin is not necessary.

When there is a bunch of drinking nuts attached to the one main stalk (*karoro*), the whole bunch may be brought down together. If the climber intends to do this, he carries a rope up with him and ties one end around the stalk. He lowers the bunch after severing the stalk with a bush knife or, if he has an assistant below, loops the rope over the midrib of a neighboring leaf and drops the end to the ground. The rope is long enough to allow the assistant to pay it out as he lowers the nuts. The whole bunch is taken home and the nuts detached as required. This applies to drinking nuts only.

Nuts may be husked in the field or at home. In either case, a husking stick is required.

THE HUSKING STICK

The husking stick bears the general Polynesian name of *ko*. In the old days, a husking stick was probably taken from home to the plantation, but today the bush knife readily fashions one in the field. The wood is preferably *woroworo* (*Premna integrifolia*). A piece about 3.5 feet long is cut off from a stem or a branch about 1.5 to 1.75 inches in diameter. The lower end is trimmed to a rounded point for sticking into the ground, but the upper end is cut at a long slant from one side so that the point will penetrate more readily between the husk fibers. The stick is driven into the ground, usually slanting slightly away from the operator.

The coconut is held horizontally by the two ends and driven down on the husking point so that it penetrates the husk on the far side of the nut. Experience teaches the amount of husk to impale without striking the nut. The husker then forces the coconut downward and levers it toward himself so as to prize off the impaled segment of husk. The nut is turned until all of the segments are removed. A knob of husk which usually remains attached to the shell is knocked off by jabbing it against the husking point, except on drinking nuts husked in the field. The process of husking is termed *oko*, the segments of husk removed, *akanga*. In some parts of Polynesia, the husk segments are impaled on the near side of the nut and the segments are prized off by outward pres-

sure, or away from the body. Either way is equally effective. Husking is a man's duty, and if it has not been done in the field, he does it at home.

A special form of basket, termed *poroporo ha matu*, made of green leaves, holds large numbers of mature nuts for conveyance to the home. All transport from the outer islands is by canoe, and, as the trip from the trees to the canoes is short, no special carrying poles like those used in Polynesia are present in Kapingamarangi.

It is an interesting sight on the Touhou waterfront to watch canoes returning from the outer islands with food supplies. Among them is always a supply of drinking nuts and mature nuts needed for various food preparations. If the observer approaches close to the canoe as it lands, the owner will invariably pick up a drinking nut, open the end with a bush knife, and hand it to the visitor with a smile and the invitation, "Ti rumata" (The drinking nut).

HAND GRATERS

Marine shells which were formerly used as hand graters have gone out of fashion. Modern hand graters (termed *koi*, with the definite article, *ti koi*) in use during our stay, are made from metal obtained from Japanese planes bombed by the United States Air Force on the island of Hare. A specimen obtained for Bishop Museum (C.10045) is shaped like a soup spoon with a straight handle. The round bowl is 1.75 inches in diameter with the front edge serrated, and the total length is 7.5 inches (fig. 12, *a*). Figure 13 shows a woman using a hand grater.

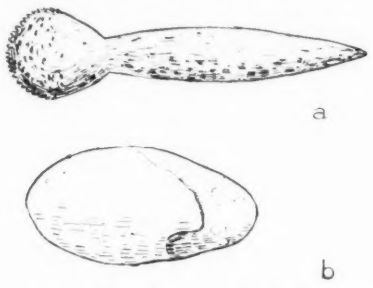

FIGURE 12.—*a*, metal hand grater; *b*, shell coconut splitter.

In the act of grating (*waru* or *waruwaru*), the pointed end of a husked nut is removed in a segment large enough to admit the fingers. Most of the fluid is poured off into a half coconut shell. The grater is held with the thumb on the inner surface near the handle junction and the meat is scraped from the shell in fine pieces with quick, light strokes. With the retained fluid, the particles form a creamy substance. The flesh on the removed cap is also grated

and added. The grated meat is termed *kaniu waruwaru*, but to distinguish it from the grated meat of mature nuts, it may be termed *kaniu waruwaru hakatc*. The qualifying term *hakatc* is used instead of *rumata* (green nut) because the grated meat is used for *hakatc* preparations.

FIGURE 13.—Woman using hand grater (Lathrop photograph).

COCONUT STAND GRATER

The hard meat of mature coconuts is more difficult to grate than the soft meat of green nuts, hence the grater has to be fixed to a wooden stand to apply the necessary force.

The old type of stand grater followed the usual Polynesian form and carried its name, *tuai*. It consisted of a natural wooden tripod formed of a length of stem with two suitable side branches to form the front legs. The stem was prolonged beyond the legs to support the grating implement which was a shell with a serrated edge. Later the shell was abandoned in favor of a flat piece of iron with the front edge serrated. The German Expedition saw the old form in use and Eilers (2, p. 9) figured two, one with a grater of *Cardium* shell and the other of iron.

A tripod model made for Bishop Museum (C.9985) is 29.5 inches long to the end of the grater arm. The round trunk of hau is trimmed flat on the upper surface for a seat, which is only four inches above ground. The upper side of the grater arm is hollowed out to fit the convex under surface of a *Cardium* shell (*tuouwe*) which provides the grating edge. The shell is 2.5 inches wide and lashed to the arm with six transverse turns of coir cord, the turns being seized from one side, across the shell, and on the other side. The

seizing makes the lashing absolutely firm so that the shell is immovable when pressure is applied in grating (fig. 14, *a*).

The stool form now in use was introduced from Nukuoro by Alfred Patterson. The seat is elliptical in shape and concave on the upper surface from front to back. The seat is supported by solid legs fore and aft; and the Museum specimen (C.10146) has a rung connecting the legs, all cut out of one block of breadfruit wood. The arm for the grater slopes up from the seat and then turns horizontally for the attachment of the metal grater (fig. 14, *b*, *c*).

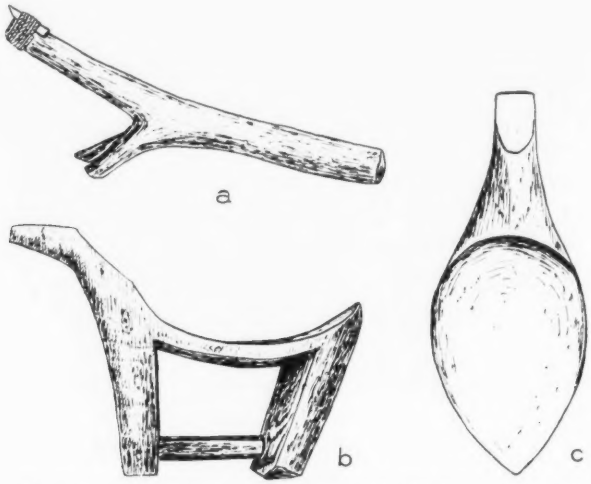

FIGURE 14.—Stand graters: *a*, Kapingamarangi (old form); *b*, *c*, Nukuoro type (introduced).

Graters for the stands were also made of Tridacna shell and *tukima* shell and shaped like adzes. We were fortunate in obtaining some specimens which were brought to us as adzes but were recognized by the elders as *tuai* graters for fastening to a stand. Two have plain edges like an adz, but are constricted near the butt end for lashing to the stand. One (C.10079) is 4.5 inches long and 2.5 inches wide (fig. 15, *a*) and the other (C.10080) is 4.5 by 2.5 inches (fig. 15, *b*). A third with a serrated edge (C.10082) is 3.25 inches long and about 1.62 inches wide (fig. 15, *c*). They average 0.2 inch in thickness.

COCONUT SPLITTERS

Although the mature husked coconut is readily split in half by cracking the shell around the middle, a special coconut splitter made of thick *Tridacna* shell seems to have been used in Nukuoro on occasion (fig. 12, *b*). A specimen presented by the pastor, Heneri, is a well-made implement (C.10106). It is somewhat elliptical in shape with the butt end rounded off and the other end

pointed. It is ground to a sharp edge on all sides except the rounded butt, and near the butt a natural depression gives a good hold for the forefinger when the implement is held by the butt end. One surface is somewhat flattened, whereas the other is convex both transversely and longitudinally. It is 6.2 inches long, 3.2 inches at its widest part, 1.2 inches thick in the middle, and 0.75 inch thick at the blunt end.

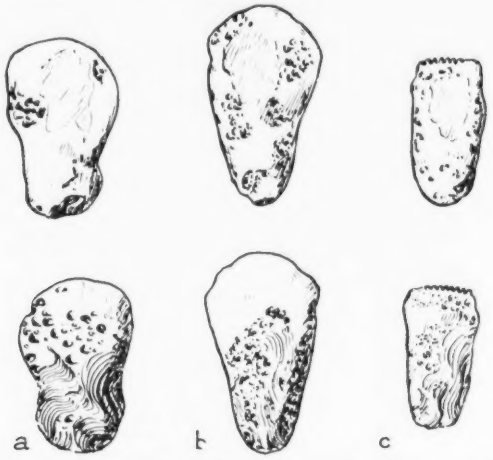

FIGURE 15.—Shell graters for stand: *a*, *b*, with smooth edges; *c*, with serrated edge.

STRAINER

The strainer which separates the particles of coconut meat from the fluid also serves as a wringer by which the fluid is expressed. It is made of three materials: hau bast (*kiri hau*), coconut husk (*puru*), or coconut leaf stipule (*kaka*). The favorite one consists of long strands of hau bast, which are folded into a pad large enough to hold a handful of grated nut. The coconut husk used is that of the green drinking nut. A segment of husk is beaten out to get rid of the inter-fibrous material and the fibers are spread out to enclose the grated nut. The husk fiber so used is termed *puru tau roro, tau* being the action of wringing, and *roro*, the coconut cream. The coconut leaf stipule has interlaced fibers like a textile and so forms a natural wringer, but it is not much used.

COCONUT PREPARATIONS

Coconut Cream

Coconut cream, which retains the general Polynesian name of *roro*, is used in various food preparations, and a large quantity of nuts are consumed throughout the year in this phase of family cooking. The cream is made by women from mature nuts which the men have husked.

A woman operator sits astride the grater stand and, with two hands, places a half nut with its inner surface over the grating end. With quick, short movements, she rubs the coconut meat against the serrated edge and the particles fall into a wooden bowl beneath. The process of grating is termed *waru* and the grated meat is *kaniu waruwaru*. To distinguish it from grated meat of the green nut, it may be qualified by the term *matu* (mature nut), as *kaniu waruwaru matu*. Light pressure during grating results in finer shreds of meat, and this technique is used for coconut cream as well as for food preparations termed *hokooto*. Heavy pressure resulting in larger or coarser shreds of meat is used if the grated meat is to be eaten without further treatment. Light grating is termed *waru hakahiki* and heavy grating, *waru hakapata*. Informants state that formerly shell graters with a serrated edge (fig. 15, *c*) were used for fine grating and shell graters with unserrated edges (fig. 15, *a, b*) were used in heavy grating. In these days, with graters having the serrated metal edge, the women can control the size of the particles by the amount of pressure they exert on the nut. As the woman cleans out each half shell, she adds some of the fluid from the nuts to moisten the grated material and thus render it easier to wring out the fluid. When no fluid is added to the gratings, the cream expressed is termed *roro moto*.

In using the hibiscus-bark strainer, a woman spreads out the strands of bark on her left hand, picks up a handful of gratings from the bowl, and places it on the strainer. She overlaps the edges of the strainer to enclose the gratings and proceeds to wring out the fluid until she can twist no more. She twists the strainer above the bowl so that the fluid falls down on the gratings within the bowl. The dry particles (*oto*) are flipped off the strainer onto a mat or basket and used to feed fowls and pigs.

The cream is added to breadfruit, taro, and *puraka* in leaf wrappings or in mature-nut casseroles before cooking. The preparations cooked in leaf wrappers are termed *hakaroi*, in nut casseroles, *putara*. To each of these groups, the name of the food is added, as *hakaroi kuru* or *putara tara*.

Wareware

The *wareware* preparation is made by pouring the fluid back into the shell with the grated meat of green nuts, mixing them, replacing the removed shell segment as a lid, and cooking in the earth oven. Thus, the original shell with its cover acts as a casserole. The *wareware* is made only occasionally as warm gruel for sick people. When members of our party developed colds, our hostess brought us hot *wareware* in the shell. The contents of one coconut shell were rather too much for one person, but it was doggedly consumed, lest the donor take offense.

Pandanus

Pandanus grows luxuriantly on all the islands of Kapingamarangi and retains the Polynesian name of *hara*. The *hara* almost equals the coconut in the variety of its uses. On Touhou, the plants are scattered among the dwellings but each tree is privately owned. The female trees are not very tall, but they all bear fruit of an enormous size and each head of leaves appears to bear fruit. A variety named *pacho* (the *c* is usually cut short and the name sounds like *paho*) has larger leaves than the *hara*. Its fruit is not eaten though parts of the plant serve minor purposes.

Varieties of the *hara* are recognized by the people as growing on different islands, and they usually give them the name of the island on which they grow; for example those on Taringa are termed *hara taringa*.

On the outer islands the *hara* are very tall. These, however, are the male trees. Height is encouraged by cutting off the side branches to procure the green leaves for plaiting. The branches are severed a short distance from the trunk in order to provide a series of steps by which the trunk can be readily climbed to remove the higher branches as the full leaf heads develop. The straight trunks grow to an extraordinary height, with some of the tops on a level with the coconut trees. The long trunks, to over 20 feet, are used as part of the woodwork of houses.

The names used in connection with the pandanus are as follows:

Pandanus: hara
Leaf: rouhara
Male flower: hingara
Fruit, very young: riringa
Fruit, large, green: haramoto
Fruit, partly ripe: hara tango
Fruit, ripe: hara (cooked, not eaten raw)
Fruit, ripe keys: hara reu, terereu (eaten raw)
One key: hua hara
Chewed ripe key: pinu (dried for fuel)
Ripe inner part cut off and cooked: kihara

The ripe fruit (*hara reu*) is bumped on the ground to separate the keys, which are held by the hard outer end, while the inner fleshy part is chewed.

The so-called ripe stage (*hara*) is evidently a stage greener than the *hara reu*. The keys are not eaten raw but are cooked in the earth oven. I have seen women placing both individual keys and larger portions of the fruit on leaves spread over the cooking stones. After cooking, the keys are chewed like ripe *hara reu*. The ripe fruit separates readily into the small segments termed keys by the botanists, and both children and adults enjoy chewing the inner fleshy parts of them.

The hard outer ends of pandanus keys are thrown into a rough coconut-leaf basket and placed in the cooking house or storehouse to dry. They are termed *pinu*. When dry, they form excellent fuel and are usually spread over the coconut husk segments in building up the oven fire. Such a fire is regarded as the best kind for cooking the ripe breadfruit preparations termed *hua kuru*.

Pandanus flour (*paku harahara*) is made by a long process which takes as many as two or three days. The inner fleshy parts of the keys (*kihara*) of very ripe fruit (*ku reu maro*) are cut off (*tu ona kihara*; *tu*, to cut), wrapped (*hi*) in a coconut leaf container (*poroporo*), and covered in the earth oven until cooked (*mo*). The cooked pandanus is put into a fairly large wooden bowl and pounded (*tuki*) with a wooden pounder. When reduced to a smooth paste, handfuls of the paste are placed on five breadfruit leaves and smoothed with the hands into a flat round pancake about 14 inches in diameter. The cakes, with a breadfruit leaf under each one, are placed in a round, coconut-leaf basket.

FIGURE 16.—Pandanus cakes on grill.

The next stage was demonstrated to me by a woman named Marakarita. She had made a fire of coconut husks and heated coral pieces, as in the process of preparing an earth oven. However, when the coral was heated, the pieces were spread out flat in the form of an open fire. She took some lengths of the midribs of green coconut leaves from which the leaflets had been stripped and laid them across some blocks of coral placed on two sides of the fire to support the bars of the grill. The grill is also termed *ti hata paku* after its function of forming a platform (*hata*) for the *paku* preparation. The round basket with the cakes was then brought forward and Marakarita lifted the top cake with its five leaves. She turned the cake over onto the grill, removed

the leaves, and smoothed out the upper surface of the cake with her hands. She then placed other cakes on the grill in the same way. In all, the grill accommodated nine cakes, in three rows of three (fig. 16). The cakes were exposed to heat (*rara*) until the under surface hardened (*mango*). They were then turned (*hurihuri*) to harden both sides (*ki mango nia pahi e rua*). After hardening, the cakes were put away in the round basket.

On the next day, the cakes were placed in the sun on a mat. After further hardening in the sun (*ka mango i ti ra*), they were again placed on the grill in pairs one above the other (*ka hakapuni nia paku, e rua*). (The term *paku* is applied to the cakes.) The cakes were turned until they were well-hardened, when they were turned over to two women, each with a large bowl and a large *tukima* shell. From their function, the shells were termed *tukima tuki harahara*.

FIGURE 17.—Pounding pandanus cakes for flour.

The women took the cakes which were hard and brittle and, holding them by one edge, beat them against the bottom of the bowl to break them into pieces. Then holding the shell with both hands, they pounded the pieces of cake with the sharp edge of the shell and rapidly reduced them to a powder termed *paku harahara* (fig. 17). The powder, or pandanus flour, can be kept and used when desired. It is simply mixed (*unuki*) with water to form a kind of porridge. After the demonstration, a quantity was brought to us and we had some for breakfast. It has a pleasant taste and would probably go well with milk or cream.

In the Gilbert and Marshall Islands, pandanus paste is made into a roll and covered with dry pandanus leaves which are lashed on with coir cords in the same way that the Kapingamarangi people treat their breadfruit preparations

termed *paku kuru*. The Kapingamarangi people maintain that they never treated pandanus in any but the way described.

Breadfruit

The breadfruit, which did not grow in the atolls of Polynesia in pre-European times, thrives in Kapingamarangi. The trees grow with tall, straight trunks which supply hulls for outrigger canoes. The upper branches frequently rise above the tops of the coconut palms. Though other varieties have been introduced in recent times, the common one bears smaller fruit than the Polynesian varieties and each fruit contains over 20 seeds, each about the size of the average olive seed. The seeds are eaten like nuts. The plant bears the general Polynesian name of *kuru*, and the following terms are used:

Plant: kuru	Seeds: hatu kuru
Small fruit: huatari	Skin of seed: anga
Full-sized fruit: huakuru	Fruit core: huna
Ripe fruit (soft): kurupara	Fruit stalk: kau
Skin: kiri	Gum: taupiki

Implements used in gathering fruit are ladders, pole pickers, and climbing ropes.

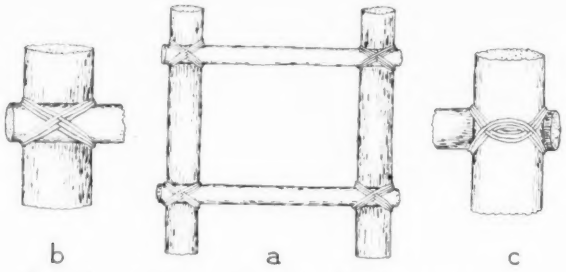

Figure 18.—*a-c*, fixation of ladder rungs.

Ladders

The ladder, termed *kakenga*, is used to reach the lower branches of the breadfruit tree which are usually out of reach from the ground. It is made of two side poles with spaced rungs and, though it resembles the European ladder, the people stoutly maintain it to be of native origin. In a typical ladder examined, the side poles were of hau, 3 inches in diameter at their lower ends and 19 feet in height. The rungs were cut to lengths of 19 inches to overlap the outer edges of the side poles and were 1 to 1.5 inches in diameter. There were 12 rungs in all, 18 inches apart (fig. 18, *a*). They were lashed to the poles with two-ply coir cord in three crossing turns forming a chevron pattern on the front of the rungs (fig. 18, *b*) and the usual elliptical pattern on the

back of the poles (fig. 18, *c*). The lashing was completed with two circumferential turns which passed around the previous lashing turns where they crossed between the pole and the rung.

BREADFRUIT PICKER

The breadfruit picker, which bears the general Polynesian name of *rou*, consists of a long pole of hau wood with a short oblique piece fastened to the upper end in one of three different ways. One form resembles the Samoan picker (Hiroa, 4, p. 116) in having a piece of wood tied by its middle obliquely across the upper end of the pole so as to form distal and proximal acute angles with the pole (fig. 19, *a*). The near angle is used to hook over the stalk of the fruit and pull it off. The far angle is used as an alternative to catch the stalk and twist it off the tree. A variation seen in use has a flat sliver of wood attached at an acute angle by one end about 2.5 feet from the end of the pole. The open fork is directed forward and there is no back hook (fig. 19, *b*). This single fork is used for ripe breadfruit (*kuru para*). The stalk of the breadfruit is caught by an upward thrust and jammed in the angle. When twisted off, the stalk is still gripped in the angle and the fruit is lowered without dropping to the ground. The small size of the fruit probably makes this method possible. In Samoa (Hiroa, 4, p. 118) and the Marquesas, some pickers have a bag net to catch the detached ripe fruit.

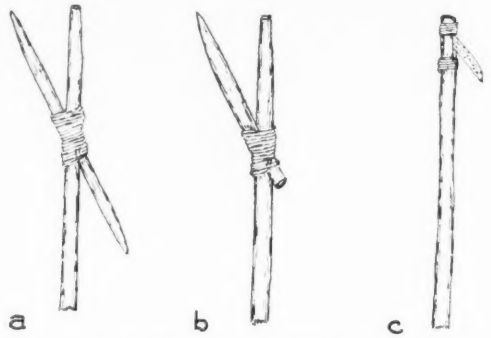

FIGURE 19.—*a-c*, breadfruit pickers.

A modern variation was in use at a tree near our dwelling. The hau pole was 16.5 feet long, 1.25 inches thick at the lower end, and 0.6 inch at the upper end. The far end was split, a knife blade inserted at an acute back angle, and the end lashed securely with hau bast to keep the blade in position (fig. 19, *c*). The implement was hooked over the stalk of the fruit, and a short jerk severed it.

Pickers are used from the ground for fruit that is within reach, but more often they are taken up into tall trees. A man takes up a position on a branch

and then detaches all the fruit within reach of the picker, shifting to other footholds until he procures the quantity required.

CLIMBING ROPE

The climbing rope is used when the lowest branches are out of reach of a ladder or when ladders are not available. It consists of any three-ply rope (*hari*) made of coir fiber as long as double the height from the ground to the lowest branch. A stone is tied to the end of a cord and thrown over the lowest branch. A rope is then attached to the cord and drawn up over the branch and down to the ground. An assistant may hold one end, or it may be tied to the trunk. A man climbs the rope by pulling himself up with a full arm stretch, bending his knees, hooking the rope below one foot with the side of the other, doubling it up under the instep of the stationary foot, and jamming it with the hooking foot. With his feet anchored, he straightens his knees, and reaches up for another full arm stretch on the rope above. In this way, he reaches the lower branch and gains access to the other branches. All tall trees are climbed in this manner.

UNCOOKED BREADFRUIT

When I was first told that ripe breadfruit was eaten raw, I thought it was an individual action of anyone too hungry to wait for cooking. However, I saw it being prepared as a regular dish during the preparation of food for a working party of canoe builders on the island of Hari.

Ripe breadfruits (*kuru para*) are lightly scraped with a shell to remove the skin (fig. 20). One woman attends to the scraping and another picks off the lumps of flesh with her fingers, separating the seeds into a basket, and discarding the core when it is picked clean. (Sometimes a shell is used.) The pieces of ripe breadfruit are placed in a wooden bowl as they are picked off. When there is a sufficient quantity in the bowl, a third woman squeezes the pieces with her fingers to form a mash. Some water is added during the mashing process. (On the canoe-building occasion, three women, each with a bowl, made the mash in sufficient quantity to feed the workers.) The mashed breadfruit has a greenish color caused by the inner layer of skin, which is not removed by the light scraping. No coconut cream is added. Formerly, the preparation was served in coconut-shell cups, but small porcelain bowls have reached Kapingamarangi. This food, termed *piapia*, was served as a first course in the meal which was subsequently provided. On the occasion mentioned, we were served with the workers, and I was surprised at the delicious taste of the food which was as good as any fruit salad I have ever tasted. I have never seen breadfruit treated in a similar manner in any part of Polynesia. The

nearest approach is the Samoan preparation of ripe bananas, termed *poi,* but it is mixed with coconut cream during the mashing process.

FIGURE 20.—Woman scraping breadfruit, with basket of peeled *puraka* beside her (Lathrop photograph).

COOKED BREADFRUIT PREPARATIONS

Whole breadfruit, after light scraping and removal of the stalk, may be grilled (*tunu*) on the embers of an open fire or, more often, on heated coral spread out without any subsequent cover. This method is quick and less trouble than cooking in an earth oven. It is also used in the outer islands when people cannot be bothered with the extra work and time involved in preparing an oven.

There are four methods of cooking breadfruit when it has reached the mature stage (*huakuru*), that is when the fruit is firm but not soft. They are as follows:

Hakate kuru: cooked with grated soft coconut meat in a green nut casserole.
Putara kuru: cooked with coconut cream in a mature nut casserole.
Hakaroi kuru: cooked with coconut cream in a leaf wrapping.
Hokooto kuru: cooked in a leaf wrapping, pounded, and mixed with grated meat of mature coconuts.

As the four methods are also used with taro and *puraka* the details of preparation will be described later.

For the soft ripe breadfruit (*kuru para*), there are two methods termed *kuru para* [*pon*] and *paku kuru*, which cannot be applied to other foods. The *kuru para* (*pon*) method is said to have been introduced from the island of Ebon in the Marshalls and hence received the additional word *bon* (*pon*) for Ebon, to distinguish it from the term for ripe breadfruit, *kuru para*. The dish is more of a dessert than a vegetable.

The breadfruit is thinly peeled (*uhe*) or left (*tuku*) as it is. In former times, according to Hetata, the skin was gently bitten off (*ngari*), as the fruit was too soft to peel with a shell, but the introduction of steel knives makes it easy to peel thinly. The fruit is patted (*papa*) with the hands to loosen (*tanga*) the core (*huna*). The stalk (*kau*) is gripped with the teeth and the fruit gently pulled away to withdraw the core, which is cast aside (*tu ki taha*).

The fruit is wrapped in three breadfruit leaves (*ka hiki ti rou kuru*) with the tips downward. The tips are folded upward on opposite ends, reaching to just beyond the middle of the breadfruit. The middle of the bundle is tied transversely with a strip of pandanus leaf or hau bast. The stalk ends of the leaves which project above the fruit are folded downward to clear the opening made by the removal of the core. Coconut cream is poured through the opening to fill the cavity (*hakahau nia roro ki roto ti kurupara*). A lump of ripe breadfruit pinched off the side is plugged into the opening as a stopper (*pono*), and the stalk ends are straightened out and tied with another strip of pandanus or hau to seal the package, which is now ready for the oven. The cooked packages were often brought to us, as the people seemed to think that this form of food would be the most appreciated by us.

The preparation of preserved breadfruit (*paku kuru*) is an interesting series of processes and illustrates the cooperation between the sexes and the division between their respective lines of duty. The first and last processes are carried out by men, the intervening ones by women.

It is the men's duty to collect the fruit and deliver it to the home, where the women take over. As one informant explained, the men of the family go by canoe to the outer island where their property is situated and pick the fruit. They make *poroporo* baskets of green coconut leaves, gather up the crop lying on the ground, carry them down to the canoe, and return home. When they have carried the baskets of fruit up to the house, their share of the work ends for the time. The breadfruit gathered is at the stage termed *hua kuru*, mature but not soft, and is kept for two or three days until it becomes soft (*para*) and reaches the stage termed *mai*.

We had the opportunity of watching the *paku kuru* processes at the home of Johannes, who was as anxious as we were that the sequence of events should

be pictorially recorded. We arrived with cameras and notebooks as the women started their part of the work. It was a family affair in which six women, old and young, shared. Two women began the chain of work by peeling the skin from the breadfruit very thinly with steel knives. On our protest, they discarded the knives and showed how the skin was removed with *pipi* shells. They also confirmed a previous statement that if the fruit was very soft, the shells were unsuitable and showed how thin layers of skin were removed by their teeth.

The peeled or scraped fruit was passed on to two other women who removed the seeds with shells and cast them into a bowl for later eating. They removed the breadfruit flesh (*kono kuru*) from the core in lumps, dropped them into the bowl they were working over, and cast the cores into a coconut-leaf basket close at hand. As the bowls were filled, they were passed on to the next couple.

The third pair had previously plaited some green coconut-leaf platters of the required size, and upon them they built up a nest of breadfruit leaves with the stalk ends outward. They placed the lumps of breadfruit in the leaf nests and covered them with some dry breadfruit leaves. The enclosing breadfruit leaves were sufficiently long to fold over the upper layer of leaves. The sides, and then the leaves at one end, were folded over. A dry pandanus leaf was passed around the folded end twice and tied by twisting the two ends and tucking them under the band. The other end was folded in and tied in a similar way. A lengthwise tie was made from end to end, and a final tie was made around the middle of the package and over the lengthwise tie. The neatly bound packages were laid aside to await transfer to the oven, which was started beforehand to coincide in timing with the preparation of the packages. The process of wrapping in leaves is termed *hi*.

When the oven was heated (*wate*), the stones were leveled. As they threw considerable heat that would scorch the food, green breadfruit leaves were spread over them. To our surprise, the fairly large breadfruit cores which had been saved in a coconut-leaf basket, were distributed over the leaves as further protection. The leaf packages, numbering six, were placed in position and also a few green breadfruit. The oven was covered and we left for the period of the cooking, which required two or more hours.

Two hours later, the call came that the oven was about to be opened (*huke*). The procedure was the same as in all cooking operations with the earth oven. The earth was scraped off with the same shells that had scraped it on; the plaited covers and leaves were removed, the mats being hung over the branch of an adjacent pandanus tree; and the cooked bundles were removed and placed in coconut-leaf baskets. As it was then late afternoon, further operations were postponed until next day.

When we were called on the following day to see the continuation of the process, cooked packages in baskets were brought out. Three women sat on coconut-grater stools (*tuai*), each armed with a long wooden pounder (*tuki*) and with a wooden bowl (fig. 21, *a*). Another woman opened the packages and emptied the cooked breadfruit into each bowl in turn. The three women mashed the contents with the pounders into a thick yellow paste of even consistency.

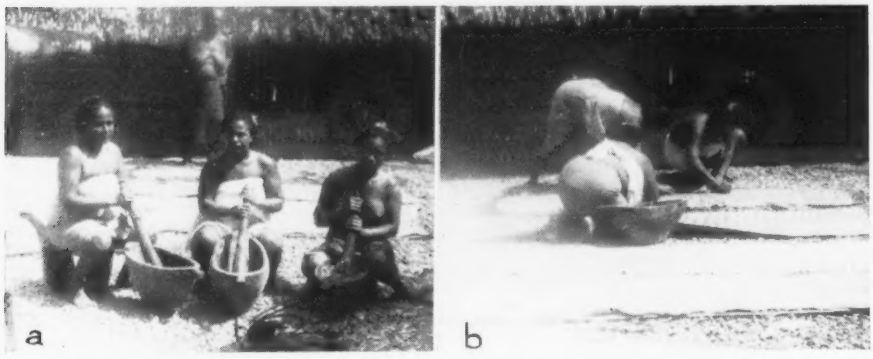

FIGURE 21.—*a*, women pounding cooked breadfruit; *b*, spreading paste to dry.

Meanwhile, other women had spread out three coconut-leaf mats in a clear space in the sun. The mats, of the kind termed *hinai*, consisted of two half mats joined down the middle with a three-ply braid. The women covered one-half of the mat with a layer of green leaves of the *nonu* (*Morinda citrifolia*), the leaves being about 13 inches long by 4.5 inches wide. They were laid in rows with the side edges overlapping slightly and the stalks distal. The next row was laid with the tip ends overlapping the stalks of the previous row. In this way, the surface of half of each mat was completely covered.

The bowls with the mashed breadfruit were brought up and handfuls were deposited on the leaf beds. The women then proceeded carefully to spread (*pa*) the paste with their hands into a smooth, even layer over the entire bed of leaves on one-half of the mat. Where the layer was judged thin, an extra quantity was added and spread out (fig. 21, *b*). The women stroked the surface of the paste with light fingers to remove any lumps and make an even, smooth surface. The golden layers of breadfruit paste on their beds of green leaves were left to dry in the sun. Three half mats accommodated the quantity of mashed breadfruit in the bowls.

In the afternoon, we were called to see the turning (*huri*) of the mats, for by then the exposed surface of the paste had dried (*mango*) until it was hard enough to prevent sticking. The bare sides of the mats were turned over to

cover the paste on the other sides. Then, holding the folded mats by each end, two women turned them over so that the under half was on top. The top half was turned back and left the sheets of paste on the other half with the leaf-covered surface uppermost. The leaves were peeled off singly, held by the stalks and stripped back to the tips. As the surface was uncovered, other women went carefully over it with their fingers to smooth out any uneven parts before the sheets were left to dry and harden. When the exposed surface was considered hard enough, the mat was reversed as before. This continued until the women experts judged that the sheets were dry enough for the next process.

The men took over for the process of rolling (*ʔeini*). Johannes, the head of the family, brought out some scraped lengths of pandanus leaves such as those used in making mats. Beside them, he laid some short lengths of hau bast, which, curiously enough, were termed *kau pacho* after the aerial root strips of the *pacho* variety of pandanus which were usually used for temporary ties. He spread out a new pandanus mat and produced a large coil of two-ply cord (left hand twist) from which he made a craftsman's coil by winding the cord around the middle finger and wrist of the left hand until it was large enough, when he severed it from the large coil. The sheet of breadfruit paste, which had dried enough to roll without sticking or tearing, was stretched out to its full extent on the new mat (fig. 22, *a*). The sheet was 8.5 feet long by 22 inches wide. Johannes explained, however, that when the breadfruit crop was more than usually abundant, much larger sheets were made and larger coconut-leaf mats (*hinai*) were made especially for drying them.

Johannes called in a younger man to assist him in the rolling and binding. The two men sat down at one end of the breadfruit sheet, turned up the edge, and carefully rolled (*ʔeini*) the sheet tightly from beginning to end in one large cylindrical roll (fig. 22, *b*). One end of the roll was rather uneven from the irregular side edge, so a piece of cord was passed around the roll about three inches from the uneven end. The two ends of the cord were pulled and the uneven end was neatly severed from the roll. The separated piece was given to us to taste, and we found it very good.

The assistant, who now assumed control, called for a food pounder, with which he tapped the ends of the roll to round off the edges. Then a woman brought a plaiting board which was shoved under the mat and under the roll to give the operator a firm foundation on which to work. The single operator took seven of the strips of hau bast and spaced them transversely under the roll, now termed *paku*. He laid the prepared pandanus strips lengthwise on the roll to cover the upper surface and part of the sides, and the seven bast strips were tied around the roll with slip knots to keep the pandanus strips in position. The roll was turned over and the projecting ends of the pandanus strips were long enough to double back over the uncovered surface of the roll.

The seven ties were slipped around to bring the slip knots to the side near the worker. The slip knots were untied and the hau strips rearranged to pass over the doubled-back pandanus strips, leaving a narrow strip on each side of the roll uncovered (fig. 22, *c*). A long strip of pandanus leaf was laid over one bare part, doubled around one end, and laid over the other bare part. The ties

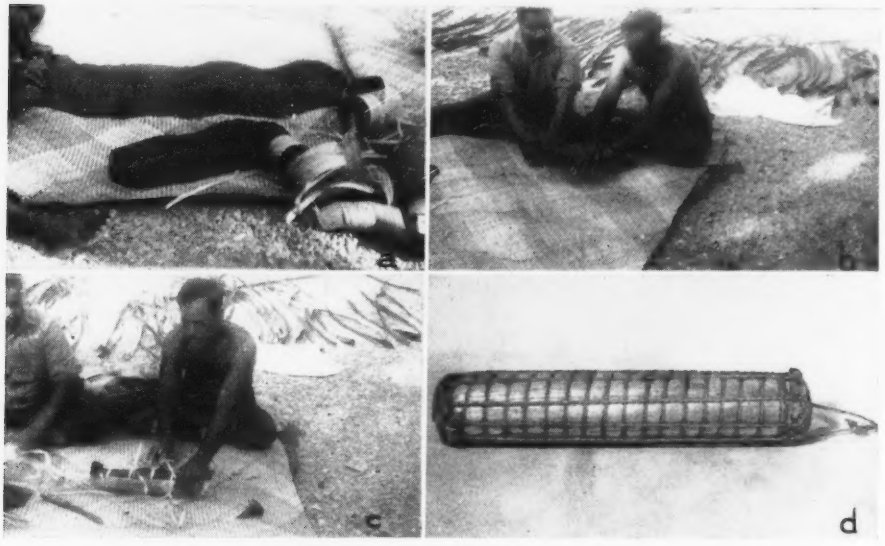

FIGURE 22.—Rolling breadfruit paste: *a*, paste rolled out; *b*, rolled into cylinder; *c*, adding pandanus cover; *d*, completed roll.

were again unfastened and retied to include the additional pandanus cover. The ties were always fastened with slip knots, for they were temporary.

The roll being completely covered, the expert proceeded to make the permanent binding of transverse spiral turns (*titi*) with the craftsman's coil. The commencement was made about 1.5 inches from the left end with two close turns with one end knotted as shown in figure 23, *a*. The coil was wound in spiral turns around the roll working from within outward over the roll, the operator revolving the roll toward himself as the winding proceeded. When the cord neared a temporary tie, the slip knot was pulled and the hau strip discarded. Considerable strain was applied to the turns; and the cord, of the left twist variety, stretched appreciably with each pull. As a turn was pulled taut, the left thumb held it down while the next turn was being made with the right hand. The oblique turns were kept parallel about 1.25 inches apart. At 1.5 inches from the right end, a complete turn was made parallel with the end circumference. Holding this down with the left thumb, two loose turns were made to allow the coil to pass under them from the right. The two turns were

drawn taut and the coil passed over and through the slack loop, which was then pulled out so that the working cord formed an overhand knot around the last two turns (fig. 23, *b*). This completed the spiral turns termed *titi*.

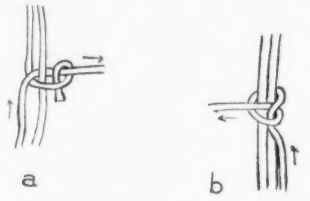

FIGURE 23.—*a*, *b*, commencement for breadfruit roll binding.

From the knot, the still connected cord commenced a series of parallel, longitudinal turns termed *taki*. The first turn was carried back to the left and passed vertically down over the left end so as to bisect the near half of the circular surface. It returned to the right on the under surface and ascended the right end vertically to divide the right end surface in a manner similar to that of the left. It came up onto the upper surface near the commencement of the first turn and ran obliquely to the left to cross over the middle of the left end. It returned on the under surface and crossed the right end surface upward in the middle line. On the upper surface it ran parallel to the left to cross the left end surface vertically in the middle of the far half of the circular surface. It returned to the right on the under surface and crossed the right end surface upward in the middle of the far half of the circular surface. The first part of the *taki* process was thus concluded with three longitudinal turns on the upper and lower surfaces and three evenly spaced vertical lines on each end surface.

The longitudinal turns were continued on the two sides and crossed horizontally over the circular end surfaces. In passing across, they were hitched around each of the vertical turns in sequence. However, as it was impossible to pass the working coil directly around the vertical turns, owing to their tightness at the end surfaces, the coil was passed around the longitudinal turns on the upper surface where the long stretch of cord could be lifted sufficiently to allow the coil to pass under it. The loop or cord was then slid down over the end to its required position. This special technique, shown in figure 24, *a-h*, is described in detail as follows:

The left end of the roll (*a*) shows the three upper longitudinal turns (1-3) and their vertical descent over the left end surface. After the third vertical upward turn at the right end, the cord makes a fourth longitudinal turn on the far side (as shown in *b*) and appears on the left side (4) of the end surface midway on the upper half of the end surface. Here it is held with the left thumb while the coil makes a half-hitch over the nearest longitudinal turn (3) halfway along its upper course.

The half-hitch shown in *c* is drawn down along the longitudinal cord (3) over the end and down to its proper position where the hitch is drawn taut. The coil is then passed under 3. In *d*, the working cord is drawn down to complete the turns around the long

cord (3) and the coil makes a half-hitch over the next long turn (2). In *c*, the half-hitch is drawn down into position and the coil then passes under the long middle cord (2) to complete the turns around the middle cord (2).

The same technique is applied to the last of the vertical turns (*f*, 1); the working cord passes horizontally to the right side and is carried longitudinally back to the right end. In *g*, the cord makes a series of hitches around the three vertical turns at the right end on the same level as on the left and then makes the fifth long turn on the left side parallel with the fourth long turn. This brings it (5) to the middle of the end surface on the left, where it has to cross in the middle line horizontally and make hitches around the three vertical cords. It is now impossible to make the hitches around the long cords on the upper surface for they cannot be slid down beyond the upper transverse row made by the fourth turn (4). The left end of the roll is, therefore, lifted and the hitches around the nearest vertical turn (3) are made on the under surface. This has been completed on the vertical turn (3) and the half-hitch around the next vertical turn (2) is shown being slid up into position.

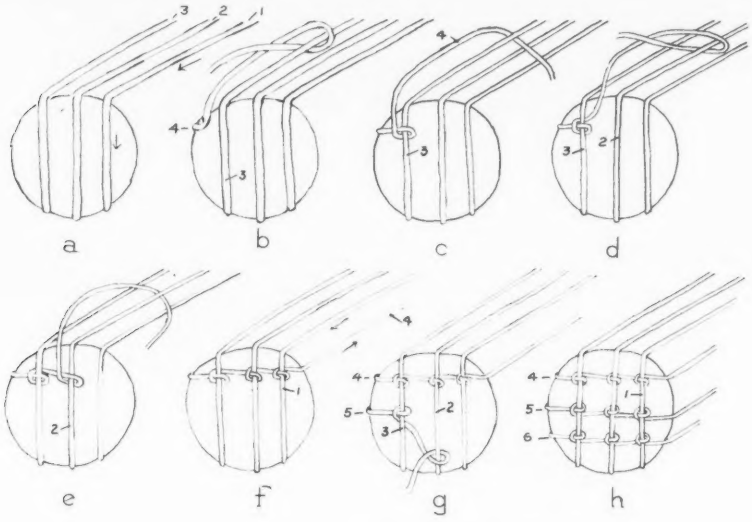

FIGURE 24.—*a-h*, breadfruit roll end binding.

The same technique of making the hitches around the long cords on the under side and sliding them up to the end position is completed on the third vertical turn (*h*, 1). The cord makes a long turn back to the right end, crosses the right end surface with turns around the vertical cords in the middle horizontal line, returns on the far side as a sixth long turn and appears on the left (6) midway on the lower half of the circular end surface. It goes through the same technique as the middle horizontal row and returns to the right end to repeat a similar process.

The completion of the lowest row on the right end practically completed the *taki* process with 12 longitudinal turns, parallel to each other and about an inch apart. However, because the first two long turns on the upper surface were closer together than the average interspace, a wide space was left on the far side between the adjacent long turns. An extra long turn, the thirteenth,

was made between them from right to left, and a hitch was made around the long turn above at a point beyond the transverse commencement turns of the initial spiral turns (*titi*). These hitches were made in exactly the same way as the end hitches and were applied to each of the long turns in sequence from left to right as the roll was revolved. When the hitches reached the commencement hitch, the end of the cord was tied to the thirteenth long turn with a clove hitch and the coil was cut.

Turning to the right end, a fresh piece of cord was used to make a similar round of hitches on the 13 longitudinal cords, in the interval between the end transverse turns of the spiral and the end of the roll. These complete rounds toward each end of the roll may be observed in figure 22, *d*. The completed roll, now in Bishop Museum (C.10038), is 19 inches long, and 3.8 inches in diameter.

Preserved breadfruit is said to keep for a long time and is used as reserve food. When needed, one end of the roll is opened up and a section cut off. It would have formed suitable provisions for long sea voyages.

Paku hou is a preparation similar to *paku kuru* but is made for immediate use. After following similar stages in cooking and pounding, the mashed fruit is made into flat, round cakes similar in appearance to the pandanus cakes. They are placed on breadfruit leaves and laid on a coconut-leaf mat to dry in the sun. When the exposed surface is dry, the cakes are turned to dry the other side. They are eaten at this stage and form an acceptable change in the menu. The preparation is termed *paku hou* in which the qualifying term *hou* means new or fresh, distinguishing it from the preserved form of *paku kuru*.

Mahi or *kiri mahi* is another form of preserved breadfruit. It corresponds to the breadfruit fermented in pits, so popular in the Marquesas and Mangareva where it bears the same name (*mahi; ma'i*, Mangarevan glottal h). In Samoa, where *h* is represented by *s*, the same preparation is termed *masi*.

The first stage of preparing breadfruit for the pit was seen on the island of Hari, where Taikuru's wife was busy scraping breadfruit with a *tuouwe* shell, cutting it into quarters, and then cutting out the hard core. The fruit was of mature size, but the flesh was hard and the seeds, which were soft, were left in the quartered fruit. The pieces were to be wrapped in leaves and placed in green coconut-leaf baskets (*poroporo hari kau*) for soaking in the lagoon.

If put in during the afternoon, they are taken out next morning, and the baskets are hung up on posts to allow the sea water to drain off. The breadfruit is then stored in holes (*rua*) dug in the ground and lined (*hariki*) with plaited coconut-leaf mats and dry breadfruit leaves. The food undergoes fermentation and is used as required. The process is used in times of plenty, when the breadfruit crop is in excess of requirements. At the time of our visit, we saw no pits in actual use.

Taro

In Kapingamarangi, the word taro (*Colocasia esculenta*) has undergone a dialectical change to *tara*. Taro was brought in or introduced in ancient times and is esteemed as the best of the local foods. A large number of varieties was formerly known, but an old man, Tukohi, could remember only the following: *mihoi, hamea, tara hapuranaihuku, hapurepure, tara ruri,* and *tara hakatiri*. The tip of the leaves is termed *matarikau* and the part cut off for planting, *matauri*.

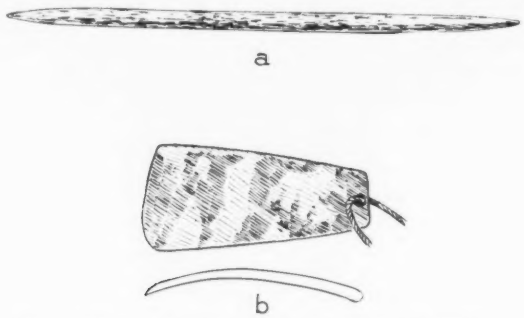

Figure 25.—*a*, digging stick; *b*, pearl-shell cutter.

The taro is planted in cultivations which are excavated down to subsoil water. The sand and coral gravel is loosened with a pointed stick, scooped up with half coconut shells into coconut-leaf baskets, and deposited around the borders of the excavations. The soil thus forms ridges in the vicinity of the gardens. These cultivations are fairly extensive on some of the larger islands, such as Werua and Hare, but there are none on the residential island of Touhou. We were told that at one time all the present sunken gardens were filled with taro, but the introduction of *puraka* has, to a large extent, displaced the taro because of its more vigorous growth and greater resistance to dry weather. The taro we ate there was as well-flavored as any I have eaten, but the corms were small, being about the thickness of a finger. Alfred Patterson said that the corms used to be much larger, but that, he thought, the taro was now recovering from previous dry seasons. Taro does not reach normal size until six months of growth, but it may be eaten at three. Probably, however, those we ate had not reached maturity.

Taro cultivation is done by women, who prepare the soil, plant, and finally dig up the mature supply needed for the home. The tool still used is a digging stick (*matako*) made of coconut wood and pointed at both ends. One presented to us (C.10135) is 42 inches long and 1.4 inches in diameter at the middle (fig. 25, *a*).

An implement called *taku,* made of pearl shell and shaped like a Manihiki hand grater but with a plain cutting edge, is used to cut off the leaf butts of the plants for planting, and also for trimming off the leaves and peeling the tubers for food. A typical specimen presented to Bishop Museum (C.10122) is 5 inches long, 1.2 inches at the butt end, and 2.3 inches at the cutting edge (fig. 25, *b*). The thickness of the shell is 0.2 inch. It has a hole through the butt end for a cord, by which the women carry it suspended from the neck.

The food preparations made with taro have already been enumerated as *hakaroi, hakate, putara,* and *hokooto.*

Puraka

The *puraka* (*Cyrtosperma chamissonis*) grows better in the sunken gardens of atolls than does the taro. (See figure 26.) Curiously enough, it was not known in Kapingamarangi until historical times. According to Alfred Patterson, it was introduced from Nukuoro by a Nukuoro woman named Nuri, who was married to a European trader named Jack Leece(?). The couple came to Kapingamarangi and settled on Werua, and evidently the woman brought some *puraka* plants with her. The new food plant caught popular favor and in the course of time was planted in all the taro gardens with rather disastrous results to the taro. However, the *puraka,* though not quite so tasty as the taro, provides a more prolific crop and now forms the staple food of the atoll.

The peeled tuber may be wrapped whole in a *puraka* leaf, tied with a coconut leaflet, and cooked; but various preparations mixed with some form of coconut are preferred.

The preparations of *hakaroi, hakate, putara,* and *hokooto* have been described (pp. 17-19), but two preparations are made from *puraka* alone. These are *tuahu* and *toro.* They both use grated *puraka* and require a special grater. It was formerly grated on a slab of coral studded closely with short projecting knobs which formed a fair grating surface. Now, however, modern homemade graters have completely replaced the coral form.

Modern graters are made of tin sheets which have holes punched closely together with a nail. The raised edges around the nail holes on the exit surface form an efficient grating surface. Three of these graters were seen in use at the same time. The tin sheets were rectangular in shape and 10 inches long by 4.5 inches wide. A piece of scantling of the same width and of any practical length formed a foundation for the tin sheets. A piece of fresh *puraka* leaf was folded to slightly overlap the wood, the perforated tin was laid over the leaf, and bound at both ends to the wood with a few transverse turns of a coir cord.

We were summoned to observe the preparation of *tuahu* by a family. On our arrival, a goodly quantity of *puraka* had been peeled ready for grating.

Three women sat with a grater before each, and the graters rested on fresh *puraka* leaves. The *puraka* tubers have a constriction which gives them an hour-glass appearance except that one end is much smaller than the other. Each woman held a tuber by the small end and rubbed the other end back and forth on the tin grater. The grated material fell on each side of the graters onto the clean *puraka* leaves. The three women worked away until all but two *puraka* were grated. When the ties of the graters were unfastened and the perforated tin removed, a layer of grated *puraka* that had worked through the holes and stuck to the under surface of the tin was added to the rest. Obviously, the green *puraka* leaf under the tin had been put there to keep clean the gratings that worked through.

FIGURE 26.—*Puraka* cultivation.

Two of the women drew up two wooden bowls before them into which they deposited a couple of handfuls of the grated *puraka*. This they proceeded to knead (*noku*) with the right hand. They used the fingers first and then the ball of the hand to work the material into the consistency of dough. The dough was rounded off with the hands into balls about the size of two closed fists (fig. 27) and laid on the green *puraka* leaves beside them.

The third woman, meanwhile, had assembled beside her some *puraka* leaves and some sheets of young banana leaves. She picked up a *puraka* leaf, shaved off the thick midrib with a knife, and tore off one part of the leaf and arranged it on the other part to make a more rectangular bed. She placed a section of

banana leaf on the *puraka* leaf, tearing off a piece if it was too large and adding a piece if too small. She reached over and picked up a ball of grated *puraka* which she placed on the banana leaf. The banana leaf was folded over the ball, the far side first, then the near side, and lastly the ends. The under *puraka* leaf was folded over in the same way, the package turned upside down, the ball flattened out by patting it with the right hand, and the package was laid down on the clean *puraka* leaves covering the ground nearby. By turning the package, the folded edges of the leaf wrapping were underneath and the weight of the package prevented them from unfolding. Unlike other leaf wrappings, the packages were not tied. All the grated balls having been wrapped, attention was turned to the oven which by this time had reached the right stage for cooking, termed *wate*.

FIGURE 27.—Kneading grated *puraka*.

Two women leveled out the oven stones, *puraka* leaves were placed over them, and the leaf-wrapped bundles of grated *puraka* were carefully laid in the oven. The two *puraka* tubers which had been left ungrated were wrapped separately in *puraka* leaves, tied with a coconut leaflet, and placed in the oven. The oven was covered in the usual way and the grated *puraka* left to cook.

The cooked packages termed *tuahu* were removed from the oven, the leaf wrappings discarded, and the contents deposited in a wooden bowl. The cakes were pounded together with a small pounder and coconut cream added in small

quantities as the pounding proceeded (fig. 28). When thoroughly mixed, the *tuahu* was ready to serve.

FIGURE 28.—Pounding *puraka*.

The *toro* preparation, usually pronounced *soro*, is made of *puraka* grated in the same way as *tuahu*. However, undiluted coconut cream (*roro mata*) is added during the kneading process before cooking. When thoroughly mixed in one mass, the dough is placed in a larger coconut leaflet basket, termed *poroporo toro*, which is lined with breadfruit and banana leaves. The mixture is covered with the leaves, tied, and placed in the oven. When cooked, portions are cut off for serving. Any left over after the meal is wrapped in smaller leaf packages and recooked (*hakamahana*, warmed) to prevent it from spoiling.

NGAUNGAU

The *ngaungau*, with larger leaves than the *puraka* and a long stem above ground, is probably a species of *ape*. It may be eaten in times of scarcity, though it is not in favor as food, as it causes irritation (*rauti*) of the mouth and tongue. For eating, the skin is sliced off (*tahi ti kiri*) and the tuber grilled (*tunu*) on hot stones. It will be noted that the term for slicing, as with a knife, is *tahi*, whereas peeling with a shell is *uhe*.

Greens

Taro leaves, which are popular in Polynesia as a green vegetable, are not so used in Kapingamarangi, according to informants. However, the stalks (*matarikau*) are cooked as a vegetable after the unpleasant tasting skin (*kiri*) is peeled off (*hore*) with the hands.

The *uhe* (*uwhe;* used as food, *huhe*), which is a creeping plant growing abundantly on Hare, is also used as greens. The younger leaves are wrapped (*hi*) in breadfruit leaves and cooked. They become a soft pulpy mass much like the *palu sami* of the Samoans, but without the coconut cream. That which was cooked for us was dry and tasteless.

FLESH FOODS

Pigs

Pigs were introduced in late historic times and are kept in small sties or tethered to a tree near the beach. Owing to their recent introduction, they have not created any special usage or custom of interest. Usually, they are killed for special occasions. We saw three killed at Ringutoru to provide a feast for a working party making a canoe. After killing, they are dragged down to the edge of the lagoon, where the hair is singed off with lighted dry coconut leaves and where the water of the lagoon is convenient for washing.

Fowl

Evidentally wild fowl have never been of much interest as a source of food supply. The *tahaunga* and *terekia*, which bred in the far islets, are said to have been eaten, but birds generally were tapu.

Domestic fowls have been introduced and supplement the food supply They may not be kept on Touhou, but breed freely on the outer islands. In cooking, they may be partly cooked on the stones of an oven before it is leveled, but the final stage is in a leaf package in the oven.

Fish

Fish provide the main flesh food, and they are caught by a variety of methods. The best for eating is said to be the sea eel, and to judge by the number of sea-eel traps seen in the canoe sheds, this must be true. Small fish are cooked in wrappings of breadfruit and banana leaves, but large fish are wrapped in green pandanus leaves. The green coconut-leaf platter termed *poroporo hiki* was plaited to accommodate the size of the package. Any fish left over was rewrapped in green pandanus leaves and recooked to keep it for another meal.

Shell Fish

The shell fish enumerated as food are *pahua, kima, ariri, pu,* and *wacanga.* All are cooked except the *pahua* (Tridacna) which is eaten raw. Though people state that they like Tridacna, it does not figure so prominently as it does in the atolls of Polynesia. However, it is plentiful near the outer islands. The pearl oyster is scarce and the black mussel (*woro*) can be obtained only in the main passage through the reef. As they are sought for fishhooks, the flesh is probably eaten.

As sea urchins (*matuke*) are eaten and are so numerous near the reef, I expected some of our companions to evince interest in them, but they did not.

BEVERAGES

The common fluid for drinking is that provided by the green coconut at the stage termed *rumata.* Large numbers of nuts are used both in the home and on the outer islands, and part of the daily food supply brought home by the canoes is a supply of green drinking nuts.

Water for drinking purposes is used to a much less extent, but many of the houses now have tanks or oil drums to catch rain water. Little is used in cooking, except for introduced articles such as rice. The native foods cooked on the open fire or in the earth oven do not require the addition of water.

WATER

Water, as I have pointed out, is little used for drinking or cooking. But it is necessary for washing clothes and bathing. Though the usual ablutions are conducted in the lagoon, some people like to finish off with fresh water. Mothers may be seen washing their babies or small children by pouring water over their naked bodies with a coconut shell. The water for washing may be obtained from a village well termed *mono wai keri.* At one time there were a number of wells in Touhou, but the tank supply of rain water has led to most of them being abandoned and covered. However, one well situated a few yards from the church and still in use when we were there had a fence of thin rods around it on three sides. It was eight feet deep and five feet in diameter, and lined throughout with small blocks of flat coral. The water was a couple of feet or so deep, and the supply was maintained during our entire stay.

While rain water lasted, the well was not used, and it became fouled with the decay of leaves which had fallen into it. One afternoon, the village community set to work to clean it out. A ladder was let down and one man descended to the bottom where he stood scooping up the water in buckets, which were relayed. Two young men sat on rungs of the ladder at different

levels to pass the filled buckets up to a man at the top who transferred the full buckets to a waiting line of 11 women. The last woman emptied the buckets out on the open graveled space, and a second parallel line of 10 girls returned the empty buckets to the well. Another young man at the rim dropped the empty buckets into the hands of the bailer as soon as he passed a filled bucket up, and great dexterity was displayed in timing and catching. An accident did occur when the timing went wrong and the empty bucket fell on the bailer's head. There was a dull thud, but instead of a burst of expletives there was a hearty laugh all round in which the culprit joined the victim.

One large receptacle was the rounded hub cap from the propeller of a Japanese plane. It held more than the buckets, and the bailer took pleasure in filling it to the brim. The women felt the weight, and it never reached the end of the line, but was emptied before it got half way. The empty vessel was passed across to the second line and its route shortened. The work was conducted with laughing and joking and finally the bailer reached the stage of scraping the bottom of the well. A coconut-leaf basket was thrown down, and the solid refuse which had accumulated at the bottom was cleared up after several returns of the basket. The working bee broke up, and next day when I looked in there was a fresh supply of water in the cleaned well.

HOUSES

INTRODUCTION

When the ethnologist nears the residential island of Touhou by surface transport, he is gratified by the appearance of thatched houses thickly studded along the lagoon waterfront (fig. 29). It is a pleasing sight after the depressing appearance of rusty corrugated-iron roofs and scrap board walls of so many of the houses in Truk. The thatched houses convey the cheering impression that the native culture still prevails, in goodly part at least. On going ashore, one finds that corrugated iron and sawn timber have reached Kapingamarangi (fig. 30), but fortunately they are limited to about six buildings in the entire village. The dwellings, canoe houses, and even sheds for fuel are predominantly of native architecture, built with native material.

When a house is to be built by community cooperation, the leading chief or expert accepted by the people decides on the details of material for the framework and on the people who should provide the various pieces. The list is then promulgated by the official policeman. The following list of material for the dispensary was copied from the list of Hetata, the policeman at Touhou. The dimensions of the pieces are given but the numbers are not, as they are well known. I have listed the number of people assigned but have omitted their names.

House Parts	Length	Number of People
Tanga· (tie-beam plates)	19 feet	3
Kioto (tie beams)	10 feet	2
Tangarua (second plates)	19 feet 10 inches	2
Oko (rafters)	9 feet 2 inches	6
Rakau pahi (purlins)	21 feet 4 inches	9
Rakau mata hare (end plate)	14 feet	1
Rakau kaurama (thatch rafters)	12 feet	15
Rakau hai ono iwi (end pieces)	6 feet	5

The end pieces are given further details as follows: *roro* (length), 6 feet; *paraha* (width), 3 inches; *matoru* (thickness), 2 inches. The posts (*turuturu*) are not included in the list, as they were to be made from a coconut tree growing on the site. This tree was felled and cut into four 10-foot lengths and the bark adzed off. The exact lengths were determined later.

Figure 29.—Canoe houses on Touhou lagoon front.

In addition to the wood for the framework, the two-ply cord (*tirahira*) with a left-hand twist was also farmed out. Ten old men who could not be expected to go out to get wooden parts were given 30 fathoms (*matatoru roho*) each to prepare. Also, 47 younger men were assessed at eight fathoms each. Thus 676 fathoms, or 4,056 feet, were readily and quickly prepared for the house.

The thatch sheets were also prepared by community labor, as described on pages 63-66. When the timber was prepared and assembled on the site, the work of building and thatching the dispensary started at 7 a. m. and was finished at 1:30 p. m.

FIGURE 30.—Our house.

The measurements used in house construction, canoe building, and for other purposes are as follows:

Matarima: the length of the forefinger, defined by the thumb flexed at the distal joint; about 3.5 inches.
Pata: the forefinger length extended to the bend with the thumb; 5 inches.
Ti anga potopoto (the short finger span): the span between the tips of the outstretched forefinger and thumb; 7.5 inches.
Ti anga roro (the longer finger span): the span between the tips of the outstretched middle finger and thumb; 8.5 inches.
Keinga i ti pukurima: from the tip of the middle finger to the wrist (*pukurima*); 8 inches.
Keinga i ti tuhirima: from tip of the middle finger to the point of the elbow (*tuhirima*).
Keinga i ti pakau: from the tip of the middle finger to the shoulder (*pakau*).
Roho e tahi: one arm span (*roho*).
Roho pahi (half span): from the tip of the middle finger to the sternum.

Thus a span and a half is phrased as *e tahi roho ma ti pahi*. The *roho* measurement is much used.

The general type of house, as regards the wooden framework, is shown in figure 31, *a*, *b*. Most of the houses are open at the sides and ends, but coconut-leaf mats are used when required to keep out drifting rain or to ensure privacy. Some have permanent walls of vertical rods forming a lattice-

work. The ground plan is rectangular and on level ground, as the dry, porous nature of the ground makes built-up ground platforms unnecessary. A second type of house, with the roof resting directly on the ground, is no longer made.

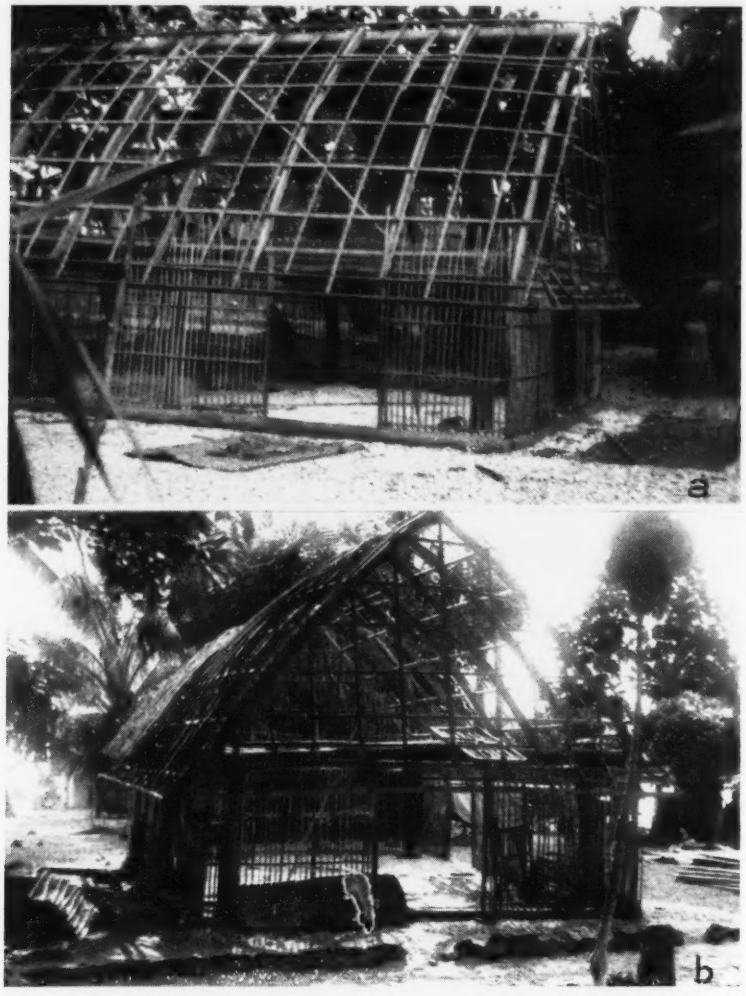

FIGURE 31.—House framework: *a*, side; *b*, end.

HOUSE CONSTRUCTION

The house studied for details of construction was a typical house next to our headquarters. It seems better to deal with one particular house first and follow with remarks about variations and differences. A rough plan of one side and a cross-section are shown in figure 32, *a*, *b*. This type house

was 22 feet long by 13 feet wide, and the interior height from the ground to the main ridgepole was 11 feet 6 inches. It was open on the sides and ends and was thatched with pandanus leaf. The native names of the various parts of the framework are as follows:

English Names	Number	Native Names
Supporting posts	4	turuturu
Tie-beam plate	2	tanga
Tie beams	3	kioto
Main rafters (one side)	5	oko
Diagonal struts (one side)	1 or 2	tarahaki
Purlins (one side)	4	rakau pahi
Thatch rafters (one side)	9	rakau kaurama
Ridgepole, main	1	tahuhu
Second ridgepole	1	iwi
Eaves batten (one side)	1	rongotara

In deciding the length of a house, the owner uses the arm span (*utoki*) as his unit of measurement. The thatch sheets are usually one *utoki* in length and, allowing for the slight overlap at the ends of the sheet, the type house was four *utoki* in length. This measurement makes it convenient in thatching and aids the owner in making an estimate of the number of thatch sheets required for the roof.

The material having been assembled from the timber supplies of the outer islands, the owner clears the ground area (*tahua*), determines the position for the posts to support the roof frame, and digs the required holes (*ka keri ti rua*).

The posts (*turuturu*), four in number, were set in the holes dug at the four corners (fig. 32, *a*, *b*, 1). The lengthwise distance between the two pairs was 16 feet and the transverse distance between the front pair was 9 feet 10 inches, between the back pair, 10 feet 4 inches. The posts were made of pandanus trunks, 5.5 inches in diameter in the middle, and their height from the ground was 4 feet 8 inches. The upper ends (*uru*) were hollowed (*hoto*) to a concave curve (*ka hoto ti uru turuturu*). Posts are also made from breadfruit and coconut trunks. Eilers (2, p. 48) mentions that many of the posts had natural forks at the upper ends; and we saw such posts occasionally in the outer islands, particularly in the rougher cooking houses.

The plates (*tanga*), which may be termed tie-beam plates in distinction from true wall plates, were two in number, one for each side (32, *a*, *b*, 2). They were formed of straight pandanus trunks, 18 feet 9 inches long, one of which ranged in thickness from 6.7 inches in diameter at the front end to 4.3 inches at the back end. The other was 5.6 inches at the front end and 6.3 inches at the back. Note that the thick ends were reversed on the two sides.

The two plates were set in the hollows on the upper ends of the posts and did not require lashing to keep them in position. (The same would apply to the posts with forked ends.) The plates projected beyond the posts for 10 inches at each end. The plates were in the natural round of the wood without any trimming except the removal of the bark.

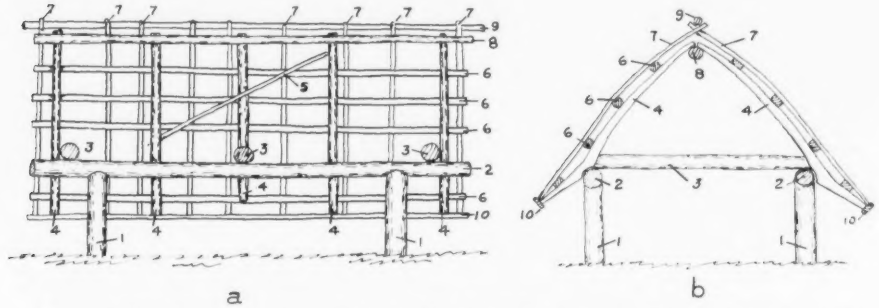

FIGURE 32.—House framework. *a*, side; *b*, end: 1, supporting posts; 2, tie-beam plate; 3, tie beams; 4, main rafters; 5, diagonal strut; 6, purlins; 7, thatch rafters; 8, ridgepole; 9, second ridgepole; 10, eaves batten.

The tie beams (*kioto*), which bear the same name as the crossbooms of the canoes, were three in number (fig. 32, *a*, *b*, 3) and were placed (*wanga*) transversely to rest on (*hongo*) the tie-beam plates (*ka wanga ti kioto ra hongo tanga*). They were also formed of smooth pandanus trunks, each 10 feet long. Though the distance between the bottom ends of the rear posts is given as 10 feet 4 inches, one of the posts was crooked and leaned inward thus allowing the rear tie beam to span the plates. The tie beams were not so massive as the plates, the front one ranging from 3.8 to 5 inches in diameter, the middle one, 3.9 to 3.2 inches, and the rear one, 4.8 to 4.2 inches at their ends. The front tie beam was to the front of the front post junction with the plate, the rear tie beam was to the rear of the rear post junction, and the third was midway between the two.

The corners (*matatuke*), formed by the end tie beams with the plates, were squared or measured (*hakatau*) by stretching a cord diagonally between corners and checking with the other diagonal (*ka hakatau nia matatuke*). This measurement is termed *ti panga*.

The position of the end tie beams having been settled by moving them on the plates until the diagonals coincided, they were lashed (*hau*) to the plates. The turns of the lashing with left-hand twisted cord above the tie beam and below the plate were arranged to form decorative patterns termed *humu*. One had the lozenge motif and the other the elliptical pattern of crossing curves, the two motifs being complementary to each other (fig. 33, *a*, 2).

In some houses, a second plate (*tanga rua*) was laid on the upper surface of the ends of the tie beams, in which case the tie beams usually projected a little distance beyond the plates at either side (fig. 33, *a*, 1). The second plate is much lighter than the main tie-beam plate and is made of dressed wood, quadrangular in section.

The next step is to get the ridgepole (*tahuhu*) into position. This is done by erecting two long temporary posts, one toward each end. A rope (*hari*) is fixed to the upper end of each post with a clove hitch. A little slack is left to form a loop, and another clove hitch made below the first to fix the loop. The end of the rope is passed through the post loop to form a long loop which reaches to the ground. The ridgepole is placed horizontally in the two loops and hauled up to the required height (fig. 33, *b*): *ka rawararawa ti hari ki tona uru, e huti ake ai tahuhu ki nua* (fasten the rope to its upper end, by which to draw the ridgepole upward).

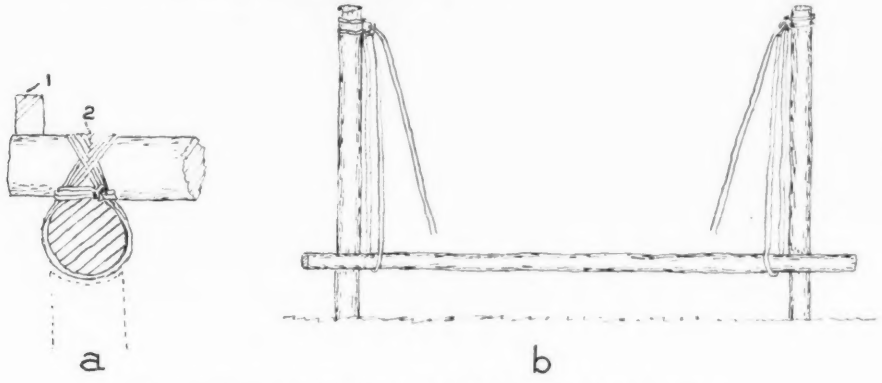

FIGURE 33.—*a*, tie beam to plate lashing; *b*, raising ridgepole.

The two pairs of main rafters (*oko*) at the ends are then lashed to the ridgepole above and to the tie-beam plates below. In the type house, the rafters were 9 feet 8 inches long. They were trimmed from tree trunks and were 1.5 inches thick by 3.8 inches deep, being set on edge. The lower ends deepened to 6.1 inches at the tie-beam plate, from which they curved outward and decreased in depth. Alfred Patterson said that the form of rafter with its lower outward curve was a late development due to the acquisition of steel tools. The dressed rafters were also slightly curved throughout their length, as shown in figure 32, *b*, 4. Formerly, the rafters were formed of thick, straight poles.

The lashing of the upper ends of the main rafters to the ridgepole could not be made out clearly in the completed house, but Patterson demonstrated the technique, which is somewhat similar to that of securing the tie beams to the plate. He said, "Nia oko e hau takitahi" (The rafters are tied singly).

The lashing is started on the outer side of the rafter as shown in figure 34, *a-g* and is described as follows:

As shown in *a*, the knotted end of the cord is laid on the left of the rafter (1) and crosses obliquely over the right top corner to make a curved turn on the opposite side of the ridgepole (2), the middle of the curve being past the midline (dotted). The cord comes around the right lower corner and crosses obliquely over the rafter to the upper left corner. It crosses the commencement end and so fixes it. *b* shows the opposite side of the ridgepole with the first curve made. In *c*, from the position in *a*, the cord makes another curved turn to overlap the first curve at the back, and reappears at the left lower corner to make an oblique turn to the right upper corner. *d* shows the appearance at the back, in which the second curve crosses the first. In *e*, the sequence of diagonal turns established by *a*, *c*, is repeated, and by keeping the turns on the outer side of the preceding turns, a lozenge pattern is produced on the main rafter. In *f*, the curved turns established in *b*, *d*, are repeated to three turns each way and the complementary elliptical pattern is produced on the ridgepole. In *g*, the cord is passed around the lashing between the rafter and the ridgepole for two or three turns and tied with an overhand knot. Those last circumferential turns tighten the lashing.

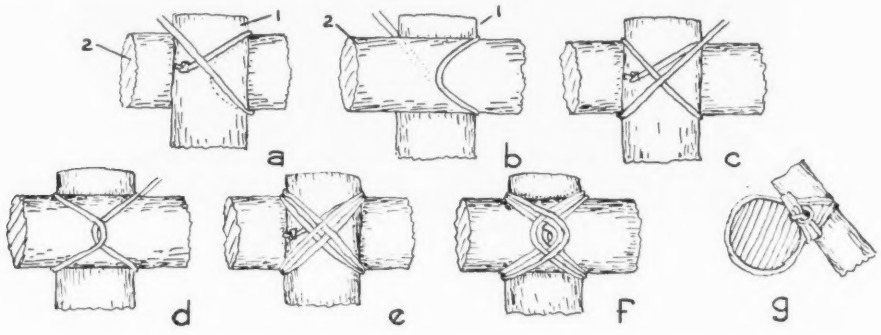

FIGURE 34.—*a-g*, lashing main rafters to ridgepole: 1, main rafter; 2, ridgepole.

The patterns developed are termed *humu*, but no distinction in name is made between the two. Having fixed one rafter, the other is treated in a similar way, which is possible because the upper ends of the pair are not directly opposite each other.

In some houses, the rafters are crossed above the ridgepole, and they may be lashed to each other and to the ridgepole as well. The general use of steel tools in modern times has led to the shaping of the ridgepole in quadrangular section, and the upper ends of the dressed rafters are cut to fit against the ridgepole on each side (fig. 35, *a*).

The lashing of the main rafters to the tie-beam plate was formerly done in the same way as that described for figure 34, with the elliptical pattern on the inner side of the plate where it can be seen as a decorative feature. In modern times, however, the acquisition of boring tools has led to the use of holes for lashing. Thus holes are bored through an arc in the circumference

of the plate on each side of where the rafter touches the plate, making two holes on each side. The inner edge of the rafter may be cut to a curve to fit closely against the plate, and a single hole is bored through the rafter opposite the mid point between the two holes in the plate. The cord passes through the hole in the plate and the hole in the rafter alternately on each side, with the result that the turns form a V-shape on each side. The limbs of the V are then seized (*riri*) on each side (fig. 35, *b*, *c*). The V-shaped pattern is termed *mataha mangarua* (*mangarua*, two branches forming a fork), and it is widely used, not only in houses but also in canoes.

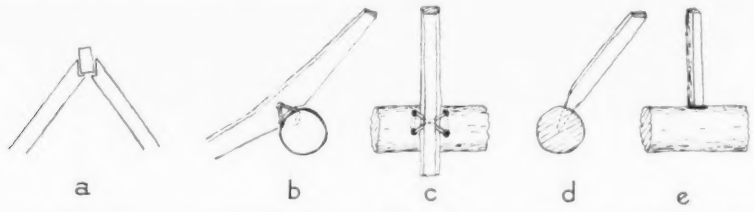

FIGURE 35.—Joins: *a*, modern rafter to ridgepole; *b*, *c*, rafter to tie-beam plate; *d*, *e*, rafter insertion.

Another method now largely used is to trim the lower ends of the main rafters into a blunt point and insert (*tongi*) them in holes bored in the upper surface of the tie-beam plates (fig. 35, *d*, *e*).

The second plate resting on the ends of the tie beams is now largely used and the rafters are lashed to it. The turns pass through a single hole in the rafter and around the second plate. The lashing turns may be arranged to form a lozenge pattern on the inner surface of the second plate.

The lower ends of the main rafters, which are not inserted into the plate, do not usually extend as far as the eaves batten, but stop almost midway between it and the plate junction. Their lower ends are defined by the lowest of the four purlins which is lashed to their outer sides.

In the type house, when the two pairs of end rafters had been lashed to the ridgepole above and the plate below, the ridgepole no longer had need for the temporary posts and they were removed. Three intermediate pairs of rafters were evenly spaced in the interval between the end rafters, and they were lashed above and below in the same way as the end rafters. These made the count five pairs in all. It follows that the longer the house, the greater the number of main rafters required. Five pairs is an average, but there may be six or seven pairs used.

The next element is the diagonal strut (*tarahaki*). The term *tarahaki* is not confined to the house framework but is also applied to diagonal struts used in making the side walls of fish traps. It is a rather thin rod or batten which extends obliquely between two rafters, usually the intermediates on

either side of the middle rafter. In the type house, there was one on each side (fig. 32, *a*, 5), and the oblique direction ran opposite on the two sides. In some houses, there are two struts on each side which cross each other. The ends of the battens are notched at each end and the lashing passes around the notch and the adjacent part of the rafter. The *tarahaki* struts help to brace the roof framework.

Purlins (*rakau pahi*) are horizontal elements which are lashed to the outer side of the main rafters to further brace the roof framework (fig. 32, *a*, *b*, 6). The term *rakau pahi* (*rakau*, wood; *pahi*, side) meaning "wood for the sides" is descriptive, and it is probable that an older specific term has been forgotten. The purlins are trimmed poles averaging 1.4 inches wide by 1.3 inches thick and extending the full length of the house. In the study house, three were evenly spaced above the tie-beam plate and one below it. The number above may range from two to four, but the one below is always present and has the specific name of *muri oko* (behind the rafter). All the others are behind or to the outer side of the rafter, but the term *muri oko* is reserved for the lowest which marks the lower ends of the main rafters. It is also useful for the attachment of mat screens and the upper ends of the rods used in lattice walls, hence its need for a distinguishing name.

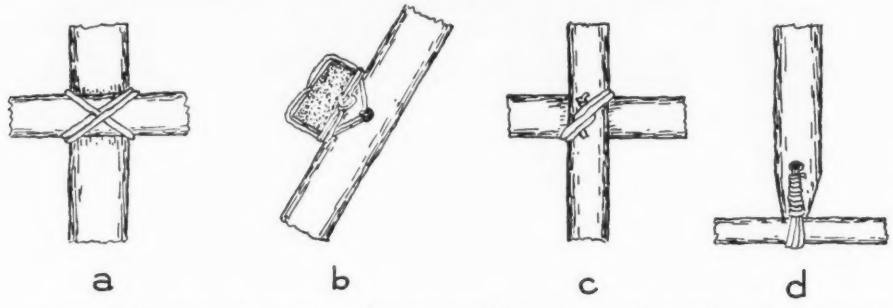

FIGURE 36.—Joins: *a*, *b*, main rafter and purlin; *c*, thatch rafter and purlin; *d*, thatch rafter and eaves batten.

The purlins are lashed to each of the five main rafters and project beyond the end main rafters to give support to the end thatch rafters which are always to the outer side of the end main rafters. In the old technique, the lashing turns passed around the purlin and the rafter, but in modern lashings, the cord is passed through a hole in the rafter and around the purlin with crossing turns on the outer side of the purlins, two in one direction and one in the other (fig. 36, *a*). In the side view, the turns diverge in V-form from the hole in the rafter, hence, as in the lashing of the rafters to the tie-beam plate, the lashing receives the name of *mataha mangarua*. The lashing is finished off with a circumferential turn around the preceding turns as they pass between the purlin and the rafter (fig. 36, *b*).

The thatch rafters (*rakau kaurama*) are next laid across the outer sides of the purlins at right angles and lashed to them (fig. 32, *a*, *b*, 7). The name of *rakau kaurama* (*rakau*, wood; *kaurama*, thatch sheet) describes the function of the wooden elements in supporting the thatch sheets, and here again it is probable that an older specific term has been forgotten. In Polynesia, the widespread term is a dialectical form of *kaho* (Hawaii, *'aho;* Samoa, *'aso*). The thatch rafters are longer than the main rafters, for they cross above the ridgepole to form a crotch for the second ridgepole and project at the lower ends below the ends of the main rafters to give support to the eaves batten. They are usually natural poles with the bark removed, but in the type house, they had been trimmed like the purlins and averaged 1.4 inches by 1 inch in cross diameters. In actual practice, the poles are longer than necessary and the excess upper length is cut off after the second ridgepole is placed in position and the crossed pairs lashed together below it. They number nine on each side, about the average for houses of the size of the type house. The end pairs are to the outer side of the end main rafters and the intermediate seven pairs are evenly spaced between. The lashing of the thatch rafters to the purlins consists of two turns of a double overhand knot (fig. 36, *c*). The lower ends of the thatch rafters are usually trimmed at the sides and lashed to the eaves batten through a hole in the lower end of the rafter (fig. 36, *d*).

The second, or upper, ridgepole (*iwi*) is a slender rod which is laid in the crotch formed by the crossed upper ends of the thatch rafters (fig. 32, *a*, *b*, 9). It is longer than the main ridgepole and the two ends rest on the median upright in the framework of the ends of the house (*mata hare*). Alfred Patterson stated that in the old houses there was a third ridgepole termed *iwi turi* (*turi*, small). In such houses, the second ridgepole must have rested in a crotch formed by the crossed ends of the main rafters, thus the third ridgepole would occupy the crotch formed by the thatch rafters.

The eaves batten (*rongotara*) is the last element of the wooden framework on the sides (fig. 32, *a*, *b*, 10). Formerly, and even now in the outer islands, they were formed of poles which were attached to the upper side of the lower ends of the thatch rafters with the double overhand knot lashing. In the present-day dwelling houses, the *rongotara* is trimmed into a batten which averages 1.9 inches in width and 0.7 inch in thickness. It is laid with the wide surface against the lower ends of the thatch rafters, which are usually trimmed and perforated as shown in figure 36, *d*. The lashing turns pass vertically through the rafter hole and around the batten, and the turns are seized on each side of the rafter. In the type house, the height of the eaves batten above the ground was 3 feet 10 inches, which was 10 inches lower than the height of the corner posts.

The end walls (*mata hare*) are formed of vertical and horizontal rods to form a foundation for the attachment of thatch sheets to close in the gable ends of the house. The arrangement of the framework, described below, is shown in figure 37, *a-d*.

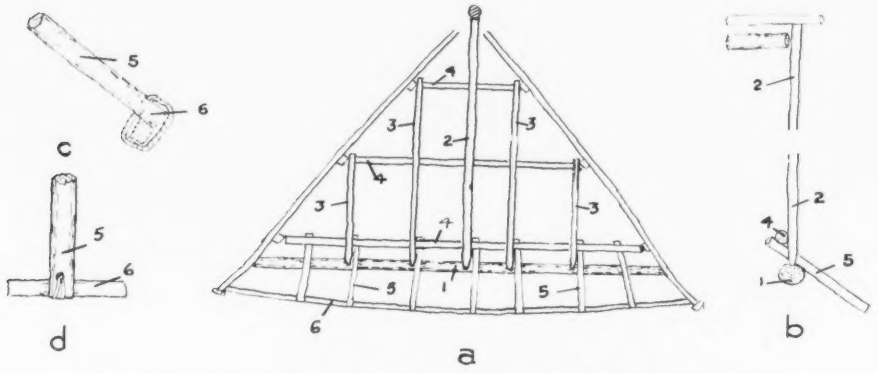

FIGURE 37.—*a*, end wall; *b*, middle upright; *c*, *d*, lashing to eaves batten.

An end beam, *ti rakau matahare*, (*a*, 1) is a beam 2.5 by 2.1 inches in cross diameters. It stretches horizontally across the end and rests on the ends of the tie-beam plates on the outer side of the end main rafters, to which it is lashed through holes bored through each. Sometimes it is lashed to the end rafters below the level of the tie beam.

A median upright, *ti pou ti matahare*, (*a*, 2), 1.7 by 1.1 inches in cross diameters, is erected on the middle of the end beam. The lower end is pointed and let into a hole on the upper surface of the end beam with no need for lashing. The upper end fits against the under surface of the second ridgepole where it projects beyond the main ridgepole and is lashed to it by turns which pass through a hole in the upper end of the upright and around the second ridgepole in the same way as the lashing of the eaves batten to the thatch rafters. This attachment is to the inner side of the crossing of the end thatch rafters under the end of the second ridgepole.

Two upright rods, (*a*, 3), 1.3 by 1.0 inches in cross diameters, are spaced on either side of the median rod, their upper ends corresponding with the ends of two upper purlins of the sides of the roof framework. The lower, pointed ends are inserted in holes in the upper surface of the end beam. (In the study house, the upper ends were pierced and rested against the lower surface of the purlins to which they were attached by a lashing passing through the hole and around the purlin in the same way as the attachment of the median rod to the second ridgepole. The builder of the study house evidently favored this form of lashing and used it wherever possible. The more common method is to lay the upper ends of the uprights against the inner side of the purlins and lash them together with the double overhand knot such as was used in lashing the thatch rafters to the purlins. In the dispensary house, the uprights were longer than necessary, and the excess length was cut off after the lashing was made. This simplified matters and made it unnecessary to accurately measure the lengths of the uprights beforehand. This more general method is depicted in figure 38. As the number of uprights corresponded to the number of purlins, there were four uprights on each side of the median upright if there were four upper purlins, as in the dispensary. In the study house, the third side purlin was so low that an upright to correspond with it was omitted.)

The horizontal rods or end purlins (*a*, 4) also correspond in number with the side purlins and cross on the purlin levels on the inner side of the uprights to which they are

lashed with the double overhand knot. (These lashings are evidently considered sufficient, for in the study house the ends were not lashed to the side purlins.)

The end walls are finished off at their lower ends with a short projecting framework which consists of seven short rods (*a*, 5) directed obliquely outward and downward to end on an eaves batten (*a*, 6). The inner ends of five of the rods are passed over the end beam (*a*, 1) on the right of the vertical rods (*a*, 3) and under the lowest purlin to which they are lashed. In addition, two other rods are added at the ends to the outer side of the end uprights, thus completing the set of seven rods. The insertion of the rods between the two cross pieces gives them the oblique outward direction required (*b*). The rods are graduated in length, the middle one being the longest.

An end eaves batten, *rongotara* (*a*, 6), 1.5 inches wide and 1 inch thick, is attached to the outer end of the oblique rods and, owing to the graduated length of the rods, forms a convex curve. The two ends are rested on the eaves battens of the sides to the inner side of the end thatch rafters and they are lashed to the side battens. In general, the end batten is laid against the underside of the rods and lashed to them (*c*). (However, in the study house, the pierced lashing was again used, a hole being made through the outer ends of the rods from above down and the lashing turns passing through the hole and around the batten, as shown in *d*.)

The framework of the dispensary (fig. 38), built while we were there, had some extra features. Instead of the tie-beam plates being placed directly on the corner posts, they were laid on oil drums and the whole framework of the roof was completed in this position. The upper part being within reach, there was no necessity to use temporary posts to raise the ridgepole into position. There were four purlins above the tie-beam level and consequently four end purlins

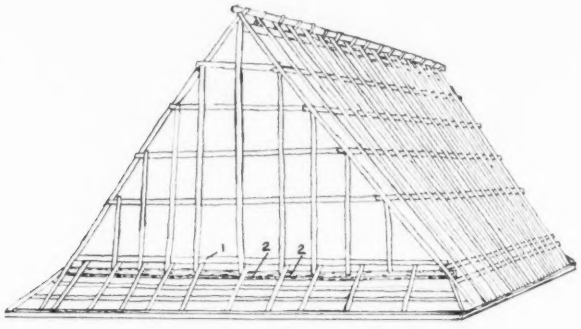

FIGURE 38.—Roof framework of dispensary.

and three uprights on either side of the middle upright in the end framework. An extra side purlin was used below the tie-beam level, and an end purlin was laid on the ends of the upper of these two side purlins. This end purlin (fig. 38, 1) formed the upper support of the end oblique rods, and the end plate (fig. 38, 2) was rested at its ends on the lower of the two side purlins. The oblique end projection was further braced by two purlins spaced between the end plate and the end eaves batten, passing beneath the rods and lashed to them. The frame also had six main rafters, which are not shown in figure 38. While

the frame was being made, other men cleared the site and erected the four corner posts which were composed of lengths of a coconut tree trunk felled to clear the space. At the same time, a number of older men were busy making the thatch sheets from the supply of pandanus leaves which had been previously carried to the site. On the completion of the roof frame, men lifted it on the tie-beam plates and carried it to the site where the tie-beam plates were laid on the notched tops of the four corner posts which had been erected to correspond with the measured distance between the tie-beam plates.

The technique of forming the end projections with oblique rods fixed between the end beam and a horizontal rod above it is used in the Cook Islands (Hiroa, 6, p. 36). The house was now ready for thatching.

Roof Thatch

The thatch material for dwelling houses and most canoe houses is pandanus leaf. The leaves (*rauhara*) which have dried (*mango*) naturally on the trees from age (*popo*) are obtained from the pandanus trees on the outer islands. As the majority of the trees are tall, a special picker (*rou rauhara*) is used to pull down the dry leaves. The picker is made of a long hau pole with a short piece tied obliquely at the far end in the same way as the breadfruit picker. Collecting the leaves and making the thatch sheets is generally a community effort. The usual procedure is to assess each family a number of thatch sheets, the family bringing in the required quantity of leaves from their property the day before. I saw an old man carry a large bundle of leaves down to the lagoon, submerge it in the shallow water, and place large lumps of coral on the bundle to keep it down. The next day, the bundle was made into thatch sheets. Soaking in salt water not only destroys any insects but softens the leaves making them easier to manipulate.

The building of the dispensary for a local young man who had been trained at the Truk Hospital was made a community task. One morning, several canoes left for the large island of Hare to get pandanus leaves, the parts for the framework having been assembled already. The canoes returned in the afternoon with their loads of bundles of pandanus leaves. The bundles (fig. 39, *a*) were tied with four spaced bands made of long strips of green coconut midrib bearing leaflets on one side. The leaflets were plaited in a flat, three-ply braid about 2 inches wide. At the right intervals, the four bands were laid on the ground near the pandanus trees. Then, as the dry leaves were pulled down with a picker, they were laid on the bands with the butts in the same direction until there was enough for a bundle. Some of them were very large, ranging in diameter at the butt band between 8 feet 4 inches and 13 feet 4 inches. The lengths averaged 10 feet.

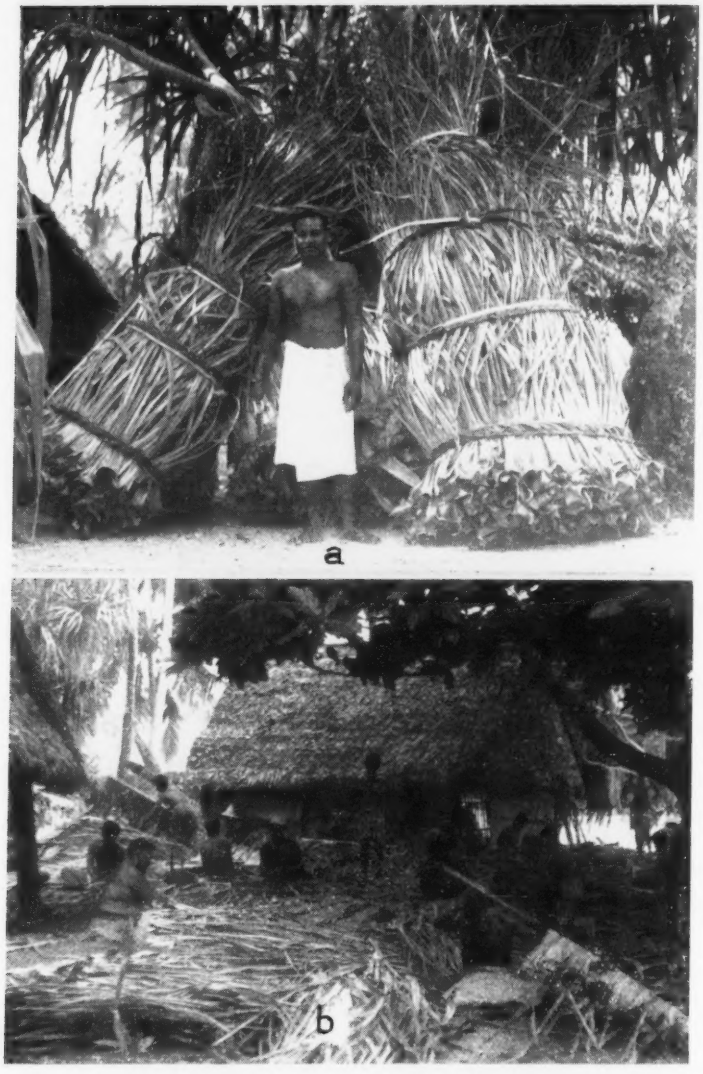

FIGURE 39.—*a*, pandanus-leaf bundles for thatch; *b*, group making thatch sheets.

On landing at Touhou, four men carried each of the large bundles up to the dispensary site. For the dispensary roof, 16 bundles were considered sufficient. These were not soaked in the lagoon but were distributed to groups of men who made the thatch sheets on the spot (fig. 39, *b*) while the builders were erecting the frame of the house.

The method of making the thatch sheets (*kaurama*) was demonstrated by King David while he sat in the Touhou men's house making his quota of sheets for the rethatching of a house at Werua. Beside him lay a bundle of dry pandanus leaves and a number of rods to which the leaves were to be attached.

The rods consisted of dry coconut-leaf midribs (*takai niu*) cut from the thinner ends of the midribs in lengths of 67 inches and with the leaflets stripped off. He had a needle (*tui*) formed of a flat piece of white metal obtained from a Japanese plane. It was pointed at each end and had a hole drilled through the middle. The old form was made of *woroworo* (*Premna integrifolia*) wood in the same shape, but one made for the Museum is of coconut wood. This needle (C.10020) is 10 inches long, 0.7 inch wide in the middle, and 0.15 inch thick (fig. 40, *a*).

The thread used with the needle consisted of strips split from pandanus aerial roots (*aka pini*) in widths of less than 0.25 inch, but strips of hau bast are also used.

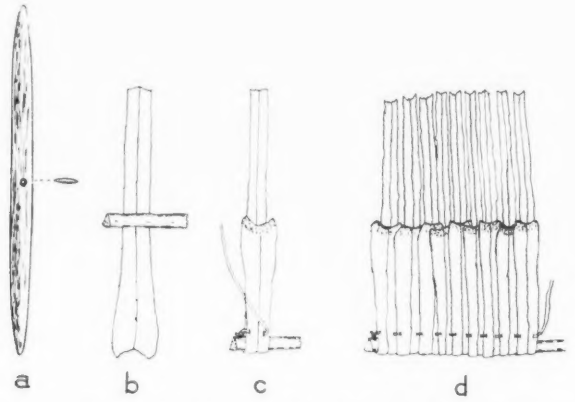

FIGURE 40.—*a*, thatch needle; *b-d*, thatch-making technique.

A midrib rod was held at the thicker end by the left hand. A pandanus leaf was picked up with the right hand by the butt end and passed under the rod with the keel or under surface of the leaf against the rod (fig. 40, *b*). The butt was drawn forcibly (*hara*) against the rod to open out the leaf, and a length of 22 inches of the butt end was doubled (*hakapika*) over the rod and held down by the left hand. The threaded needle was stabbed through the left side of the doubled portion immediately above the enclosed rod, the end of the thread tied in a knot around the left edge, and then drawn up through the surface on the right side of the leaf (fig. 40, *c*). The needle drew the stitch taut and it was stuck into the leaf while the right hand passed another leaf under the rod on the right, rubbed it against the rod, overlapped the right side of the fixed leaf, and doubled the butt end over the rod for 22 inches. The needle was

picked up and stabbed through the left side of the added leaf and the overlapped part of the previous leaf. The thread was drawn taut and the needle passed up from underneath through the right side of the added leaf. So by the successive overlapping, the rod was covered toward the right (fig. 40, *d*) until the end was reached and the sheet finished. The completed sheet was thrown to one side and the process of covering the rods continued until the required quota was reached.

Though the current name for the thatch sheets is *kaurama*, the pandanus sheet is more correctly termed *kauhara* (*hara*, pandanus). In the completed sheet, the doubled-back butt ends are termed *tahita* and the leafy tip ends, the *hiku*. In thatching, the surface with the *tahita* butts is always on the inner side against the thatch rafters, with the exception of the first or lowest row in which the butt ends are to the outer side. As the butt ends are 22 inches from the upper edge of the sheets and the spacing between rows of thatch is never more than 5 inches, the butt ends are behind the preceding row and are not seen from the inner side of the house. The rubbing which the leaves receive makes the inner part of the thatch, which shows, even and without wrinkles, whereas the outer side of the thatch is rough and somewhat straggly in appearance because of the unopened *hiku* ends.

The making of pandanus thatch sheets differs in some details from that of central Polynesia. In Kapingamarangi, the dry pandanus leaves are rubbed against the thatch rod singly as the sewing proceeds. In the Cook Islands, the leaves are rubbed against a round stake fixed upright in the ground (Hiroa 3, p. 13), and all of the leaves are rubbed and tied in a bundle before the sheets are started. The Cook Islands wooden needle has no hole, for a thread is not used. The needle is pushed through the doubled portion of the leaf on the flat and then turned edgewise to open up the hole through which dry coconut-leaflet midribs are passed to pin the parts together. Whole coconut-leaf midribs are not used as thatch rods in central Polynesia, but are split to form more slender rods. Split pandanus aerial roots are also used as thatch rods. In Samoa, sugar-cane leaves were used over a rod instead of pandanus.

According to local informants, the houses in Kapingamarangi were thatched with coconut leaves in olden times. Pandanus thatch was introduced by Kowai, who is said to have come from Tarawa with his wife, a cannibal who kidnaped children to satisfy her appetite. She caused considerable disturbance until she was driven from the atoll, but tradition is silent concerning the fate of her husband.

THATCHING A HOUSE

Thatch sheets which had been made during the past week for a house at Werua were carried there and the numbers checked by the local policeman.

We had arranged beforehand to take photographs and moving pictures of the thatching and did, as a matter of fact, get good pictures of the whole process. On being notified, we walked across from Touhou to Werua. The house had been stripped of the decayed thatch, and the policeman, with pen and paper, checked the late contributions of thatch sheets as they arrived.

Before thatching commenced, I made a preliminary study of the house framework. With some minor differences, it corresponded with the general plan of the house already described. The ends of six pairs of main rafters were inserted (*tongi*) into holes in the tie-beam plates. These main rafters were crossed over the main ridgepole (*tahuhu*) and tied together and to the ridgepole. On each side there were five purlins (*rakau pahi*) and nine thatch rafters (*rakau kaurama*), the end thatch rafters being to the outer side of the end main rafters. The thatch rafters crossed above the ridgepole and were tied together at their crossings, the upper crotch supporting the second ridgepole (*iwi*), and the lower ends of the rafters were inserted into holes in the eaves batten (*rongotara*) without any ties. The eaves battens were kept in position by four stays of cord extending between the battens and the lowest purlin. These stays were drawn taut and seized throughout their length. The framework at the ends was similar in all respects to the Touhou house, and there was the same ignorance regarding specific terms for the end parts. They were merely referred to as *ni rakau o ti matahare* (the wooden parts of the house end).

A preliminary step was that of dividing a large loose coil of left-hand, two-ply coir cord into lengths for the use of individual thatchers. The large coil was placed on the ground below a tie beam. A two-arm span of the cord was measured off and, with the mark held by one hand, the end of the coil was passed over the tie beam. The end of the cord was tied to the two-span mark on the standing part to form a coil which was around the tie beam. The small coil was drawn taut against the tie beam, and the craftsman proceeded to revolve the coil toward himself to form continuous coils of the same length. An assistant held the standing part of the cord taut so that the additional small coils would not sag. When the augmented coil was large enough, it was cut off from the standing part. The whole coil around the tie beam was cut through in one place with the result that a number of separate lengths was provided, each two spans in length. These individual lengths are termed *uka*. The cord was 3 to 4 mm. thick, and the left-hand twists were four to the inch.

The thatch sheets were 5 feet 5 inches in length, and the length of the house was 20 feet 4 inches. It thus took four sheets to complete a horizontal row, which is termed *ti atu kaurama*. The four sheets end to end measured 21 feet 8 inches, but the extra 16 inches were absorbed by the three overlaps.

The thatching party had by then arrived, and nine men took up their posi-

FIGURE 41.—*a*, thatch sheet, first row; *b*, nearing ridgepole.

tions inside the house and behind each of the nine thatch rafters on one side of the roof framework. Each thatcher was equipped with a short, pointed stick and an *uka* length of cord. They proceeded to tie the cords with a running noose around the lower ends of the thatch rafters where they were narrowed for insertion into the eaves battens. Thus the tie would not slip up on the rafter. A number of men stood outside to hand up (*wanga*) the thatch sheets to the thatchers (fig. 41, *a*, *b*). The thatchers stood on the tie-beam plate and,

all being ready, called "kaurama." The assistants spread along the outside handed up four *kaurama* sheets. The thatchers bent forward, seized the stiff upper edges of the sheets, and placed them against their respective thatch rafters at a distance of about 6 inches above the eaves batten. Holding the line level, each thatcher stabbed his pointed stick through the thatch sheet below the stiff enclosed midrib and to the left of the thatch rafter. He drew his cord taut from below, passed it over the upper edge of the sheet on the right of the rafter, back through the hole on the left, and over and under the standing part of the cord to make an overhand knot. He drew the knot taut to the right of the rafter, as shown in figure 42, *a*. On the three thatch rafters where the sheets met, they were overlapped for about 5 inches, the end of the right sheet on the outer side of the left sheet, care being taken to keep the upper edges level. The thatcher then treated the two sheets as one by making the hole on the left through both sheets and making the overhand knot around both in the same way as for a single sheet (fig. 42, *b*). The first row of thatch (*atu kaurama*) with the butt ends to the outside is shown in figure 41, *a*.

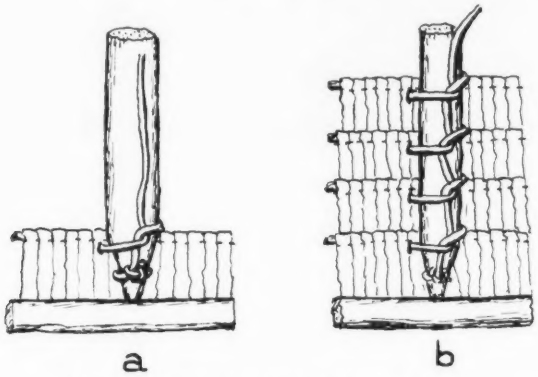

FIGURE 42.—*a*, *b*, tying thatch to rafters.

The subsequent horizontal rows are tied in the same way, but with the butts inside. As the sheets are of the same width, there are four vertical rows of thatch sheets as well as the level horizontal rows. The vertical rows are termed *unoki* in distinction from the horizontal rows (*atu kaurama*). To overlap the sheets is termed *hakakake*, but the joining by lashing is *tutakinga unoki hare* (closing the vertical rows of the house). To place close together is *hakapiri*; a short overlap is termed *e hakapiri e poto*, whereas a long overlap is termed *e hakaoko ra*.

The spacing between the horizontal rows involves the question of measuring, which is termed *hakatau*. Two measures are used in thatching, *matarima etahi* (one forefinger) and *pata* (the length of the forefinger back to its fleshy

junction with the thumb). In practice, the left forefinger tip is rested on the upper edge of the fixed sheet below and the thumb, flexed at its distal joint, gives the position for the top edge of the new sheet (fig. 43, *a*). This method gives the measurement, about 3.5 inches, by feel. The *pata* length, about 5 inches, is gaged by resting the forefinger tip on the upper edge of the fixed sheet and drawing up the upper edge of the new sheet until it rests against the junction between forefinger and thumb (fig. 43, *b*). The measurements are made on the inner side of the sheets.

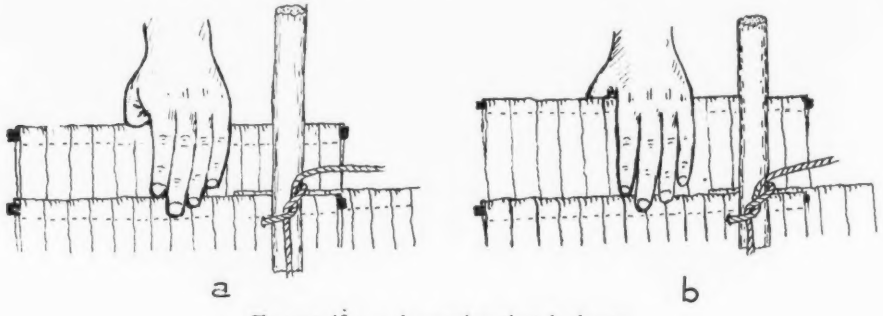

FIGURE 43.—*a, b,* spacing thatch sheets.

As the rows ascended, the thatchers shifted position onto the nearest purlin and bent well down to the sheets. When four of the nine thatchers left to commence thatching on the other side of the roof, four of the remaining five had to attend to two rafters each. When the assistants outside could no longer hand (*ɯanga*) the sheets up, they threw (*hutu*) them up, end on, with a twist which made them curve horizontally into the hands of the thatchers. (See figure 41, *b*.) It was rather strenuous for some of the older men, who resorted to a long pole with a pointed end. The sheet was impaled near the top edge and pushed up to the higher elevation. As the thatchers required material they shouted "kaurama" for sheets and "uka" for cord.

During the thatching, a man inside the house kept an eye on the rows as they were being tied. If the horizontal line was crooked, he drew attention to it and the sheets were shifted a little until the line was straight and parallel with the one below. This, however, occurred seldom.

The two topmost rows were lashed to the crossed end of the opposite thatch rafter and to the second rĭdgepole (*iɯi*), making 37 horizontal rows on each side. This stage was referred to as "ku tae ki ti iwi, ku puni" (reached is the second ridgepole, it is closed).

Though the thatch on each side had closed in at the second ridgepole, further steps had to be taken to seal off the ridge. The sealing process, termed the *huiaki*, is described below (fig. 44, *a-c*).

The two thatch sheets (*a*, 1, 1′) are attached to the crossed ends of the thatch rafters (*a*, 3, 3′) and two others (*a*, 2, 2′) to the second ridgepole (4). A doubled cord (*b*, 6) is passed through under the second ridgepole, and a thatch sheet (7) is laid over the second ridgepole with its stiff upper edge on the other side of the ridgepole. The doubled cord on the leaf side of the sheet is worked up between the leaves. A second sheet (*b*, 7′) is placed over the ridgepole from the other side with its upper edge on the side opposite that of the first sheet. The doubled cord is pushed up between the leaves on that side. In this first pair of sheets, the surface with the doubled-back butts is on the underside as in the general thatching. A second pair of thatch sheets (*b*, 8, 8′) is added in a similar way but with the butt ends on the upper side. The doubled cord is drawn through the leaf parts on each side. The doubled cord is drawn taut on each side and tied above in a reef knot (*c*, 6).

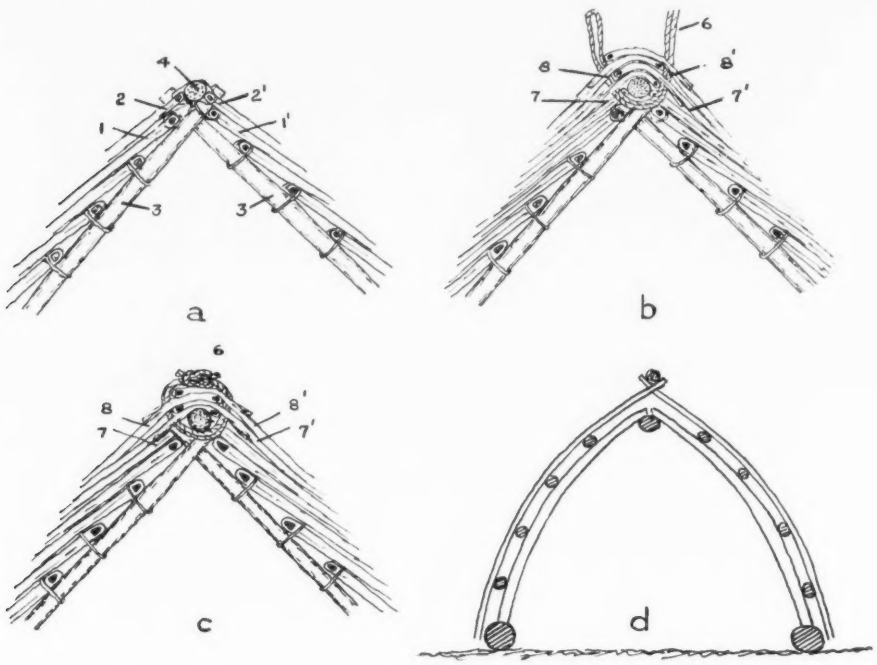

FIGURE 44.—*a-c*, covering ridge; *d*, frame of house without walls.

The two extra pairs of sheets crossed over the ridgepole prevented leakage between the second ridgepole and the last row of thatch sheets (44, *a*, 2) attached to it. The *huiaki* ties were repeated at intervals along the ridge.

The last process on the ridge was laying *tapakau* coconut-leaf mats lengthwise along the ridge, bending down the two sides close to the thatch, and pinning them down with long wooden pins which passed through horizontally from side to side under the second ridgepole. This was done along the whole length of the ridge. The plaited *tapakau* mats with the ends of the pins on

either side can be plainly seen in all thatched houses. The pins used in the Werua house were of coconut-leaf midribs, but other stakes could be used.

While the main roof was being thatched, other men thatched the *matahare* ends of the house with a similar technique. The first row of thatch was laid over the slanting rods and the sheets tied to them. Other rows were added until the upright part of the frame was reached. The thatch rows were then tied to the vertical rods of the frame. The ends of the rows were on the inner side of the end thatch rafters of the sides. As the triangular end area narrowed, the thatch sheets were cut to fit in with the shortened rows. Usually the apex was too small to close, so it remained open and was useful for ventilation. The thatcher worked from the inside, while an assistant on the outside handed up the thatch sheets.

We timed the thatching and it took about an hour and a half to complete the job. The trimming of the side edges where the leaves hung down over the eaves battens on the sides and ends was left for another day. While the thatching was proceeding, the women of the family to whom the house belonged were busy preparing a meal for the workers. The job finished, the workers sat down in groups to enjoy the repast.

CUTTING THE THATCH

Cutting the thatch on the eaves of houses was an important ceremony in parts of Polynesia. In Samoa, the building experts were concerned only with erecting the framework and the thatch was applied by the family of the house-owner. Thus the carpenters finished their work and went home before the thatching was finished, though the head carpenter returned to cut the thatch. In Hawaii, the cutting of the thatch over the doorway was regarded symbolically as cutting the navel cord (*piko*) of the house, and it was conducted with a religious ceremony by a priest.

FIGURE 45.—Thatch-cutting implement.

In Kapingamarangi, no special significance appears to have been attached to the process. However, a special instrument made of the teeth (*niha*) of the barracuda (*mara*), hence termed *niha mara*, was formerly used to cut the thatch. In a model made for Bishop Museum (C.10032), the lower jaw of a barracuda with closely set, sawlike teeth is split lengthwise from the back for a short distance. The upper part is placed in the split end of a straight wooden handle and lashed firmly with close turns of a fine coir cord. The back end of

the lower half of the jaw is included in the lashing turns. The wooden part, including the handle and the part lashed to the jaw, is 9.5 inches long, and the barracuda jaw is 3.2 inches long (fig. 45). The actual instruments were much larger than the sample.

Though the function of the implement was primarily associated with cutting the thatch of newly thatched houses, it could be used for other purposes.

House Walls

With the thatching of the roof and the spreading of clean coral gravel over the floor space, the house was ready for occupancy. The open walls let in the air and the thickly thatched roof made it much cooler than the modern board houses with corrugated-iron roofs.

Figure 46.—*a*, *b*, side and back view of dwelling house; *c*, *apaapa* house wall; *d*, roof interior.

There are two methods of closing in the walls and ends, one temporary and the other permanent. The temporary method is with large coconut-leaf mats of the *hinai* and *tapakau* types. The mats are hung lengthwise by attachment to the lowest purlins (*muri oko*) on the sides, and a second row overlaps them as their lower edges rest on the ground. The attachment to the purlins brings the wall in from the edge of the thatch and so avoids the drip from the roof in rainy weather. Sometimes the *hinai* mats with their stiff midrib edges are simply propped up on end against the lower purlins.

Permanent walls (*apaapa*) are found in a majority of the houses. They are formed of straight rods set close together with their lower ends inserted in long pandanus trunks (*pacpac*; in full, *pacpac tahi kirikiri*, beam that keeps in the gravel). These are laid on the ground along the sides directly below the lowest side purlins. The upper ends of the rods are tied to the lowest side purlins. At the back end, the pandanus trunk is laid below the end beam to which the upper ends of the vertical rods may be attached. Two horizontal rods are spaced between the pandanus beams and the upper purlin attachment and these are tied to the rods with continuous oblique overhand lashings (fig. 46, *c*).

The back end of the house is completely closed in by the wall but the front end has an opening left for an entrance. Eilers (*2*, p. 51) states that doors were made of easily moved laths. At the present time European doors have been copied in a few houses, but in many, a coconut-leaf mat is used to close the entrance. Figure 46 *a-d* shows a completed house with details of mat and lattice walls and interior view of the rows of thatch on the roof.

House Without Walls

A second, wall-less, type of house was described by Eilers (*2*, p. 47) as being made on the island of Hare. He figured a section of one side with curved rafters which had a short projecting branch on the lower end to the outer side and showed the rafters inserted into ground beams at their lower ends. The purlins and thatch rafters were the same as in the houses described above.

Our informants stated that the roof framework was identical with that of the raised houses and that the rafters were inserted into pandanus trunks laid on the ground. These pandanus trunks correspond to the tie beam plates of the present houses but are supported by the ground instead of corner posts. Except for the tie beams, if the tie beam plates of the dispensary had been laid on the ground instead of being elevated on corner posts, the structure would have constituted the Hare type of house. A section of the house would probably have been like that drawn in figure 44, *d*.

According to Alfred Patterson, the *hare tongi* were built on Hare as places for people to hide from spirits (*aitu*) which came in from the sea. *E hakamuni ni aitu takapo tai* means "to hide from spirit groups from the sea." The idea evidently was that people could be seen in normal houses with open sides, whereas they could not be seen by the spirits when the roof came down to the ground. At Touhou, according to Patterson, the people could be protected from the spirits by the *ariki* priest who resided there but at Hare they had no such protection. He also stated that the *aitu* came in from the sea during the middle part of the day, about 11 a.m. to 2 p.m. Hence, women working in the *puraka* cultivations in the outer islands took care to return to Touhou before the dangerous period started.

COOK HOUSES

Cooking houses (*hare imu*) are made in the same way as the dwellings but are smaller and made with less care and with rougher material (fig. 47, *a*.) Constant features are the four posts and the two tie-beam plates. Usually there are three tie beams and five main rafters. The rafters, however, are usually inserted into holes in the tie-beam plates made of pandanus trunk. The number of purlins is usually reduced, some having two; but some rougher houses in the outer islands have no purlins. The thatch is invariably of coconut-leaf sheets tied to rafters which function as main rafters and thatch rafters. A cooking house seen on Hare had three ridge posts with forked ends to support the ridgepole, one post being in the middle. This house had no tie-beam plates,

FIGURE 47.—Cooking houses: *a*, pitched roof; *b*, flat roof.

tie beams, or purlins, the rafters coming direct to the ground. The oven (*imu*) is always at one end. A rough shelter with a flat roof may be used (fig. 47, *b*).

The cook house contains materials connected with the actual cooking: *rua imu* (oven hollows), *tohumu* (fuel), *nia hatu imu* (stones for the oven), *tanga imu* (oven covers), *kerekere* (earth for covering the oven), and *ipu niu* (half coconut shells for scraping dirt to cover oven). Food and food utensils were stored elsewhere. The food was prepared outside in the open, usually, and then the leaf packages and casseroles were carried in baskets to the cooking house.

CANOE HOUSES

Canoe houses are called *horau*, a dialectical form of the name used throughout Polynesia. They are built on the same architectural plan as the dwelling houses but are much larger in order to contain the family canoes and also store materials, usually those connected with fishing. In the Touhou canoe house, used also as a men's house, the length from the outer side of the end posts on one side is 42 feet and the tie-beam plates, which project a foot at each end, are 44 feet long. There are seven posts (*turuturu*) on each side. The width from the outside of the end posts is 18 feet 9 inches, and in the middle it is 19 feet 6 inches. The lower edge of the side thatch is 17 inches from the posts. The tie beams number five, two being in the middle and two at one end. The rafters are 10 in number and 12 feet 8.5 inches long. The second rafter from the lagoon end is carved with four circles, three crosses, and two fishes. The fishes are said to be the *araara*.

The thatch is pandanus and the buildings are placed with the end toward the lagoon so that canoes can be drawn directly into them. (See figure 29.)

Practically every family of any status has a canoe house on the waterfront. Most of them are on the lagoon side, but a few are on the seaward side, due probably to the position of the land held by the family. The tie beams form the flooring of an upper story in which are stored the canoes not in immediate use. When closer flooring is needed to support smaller objects, it is easy enough to rest some extra poles on the tie beams and the plates. The canoes in active use are drawn up onto the floor. The canoe house is used to store men's equipment connected with the canoes and fishing. These include canoes, sails, masts, paddles, canoe poles, bailers, ropes, nets, fish traps, cordage, dry coconut leaves for torches, and other articles. When the men are weaving cloth, the loom and cloth are rolled up in a pandanus mat and placed in the loft. Sometimes fuel is stacked in the family canoe house. And some families use part of the canoe house as a residence by screening off a portion with coconut-leaf mats. For study purposes, the contents of the canoe houses are of great interest.

At both Touhou and Werua, a canoe house was used as a men's house. Even with the canoes in place, there is ample room for men to sit on the

floor and carry on various occupations such as twisting coir cord, making belts, and even weaving. The Touhou house was also used as an assembly place when matters concerning the people had to be discussed. When a ship arrived, the trading operations of the U. S. Commercial Company took place in the canoe house.

OTHER HOUSES

A well-organized family has four houses: the dwelling house (*hare nohonga*), canoe house (*horau*), cooking house (*hare imu*), and an extra store house termed a *hare mo me* (house for things). The storehouse is used for the material not placed in the other houses. This consists of wooden bowls, pounders, grating stands, baskets and mats not in use, reserve pandanus leaves, some cordage, and the loom if not kept in the dwelling or canoe house. Some roughly made storehouses with coconut-leaf thatch are used to store stacks of coconut husks for fuel.

In the outer islands, where visits are not protracted, the houses are often referred to according to their function, such as *hare mo me* as the worker's house where he might store things for the time being, and *hare hakamaroro* where people rest (*hakamaroro*) from their labor in the cultivations or from gathering material.

Mosquitoes (*namu*) are very bad on some of the islands with sunken *puraka* gardens, and a rest house has been built on one of the little islets nearby to escape from the pests, particularly at night. Though the houses are made like any other house, they are termed *hare namu* (mosquito house). One such house was observed on the little islet of Rangiate close to the large, cultivated island of Ringutoru.

A curious little house on Hare had been built by a man as a fowl house. It was 8 feet long, 3 feet 10 inches wide, and 5 feet 6 inches high. The walls were closed in with rods but the framework followed that of the dwelling houses in detail and was done very neatly.

Houses of the dead, described by Eilers (2, p. 52) as resembling cook houses with no covering of the walls, had gifts placed in them for the dead who were buried beneath. Probably these were shelters erected over graves as a mark of special respect. It is a common practice in Polynesia to lay gifts or property belonging to the deceased on the graves which are often protected by a roof raised over them.

HOUSEHOLD EQUIPMENT

Introduction

The dwelling house, besides its carpet of clean white gravel (*kirikiri*), has pandanus mats (*kahara*), round coconut-leaf baskets (*kata*) for clothing, the

hinai and *tapakau* plaited coconut-leaf mats for wall screens or rough carpets, prepared rolls of pandanus leaf kept by the women for plaiting mats, a baby's hammock, and perhaps the rolled-up loom when not in use.

Floor Coverings

Coconut-leaf mats for the first floor covering and pandanus-leaf mats for top floor covering for sleeping are necessary parts of the household equipment. In olden days, sheets of bark cloth were used as sleeping covers, but cotton sheets are now in general use.

Containers for Clothing

Clothing was formerly kept in the round coconut-leaf baskets (*kata*), which are still used to some extent. But some people have wooden chests, and a type of box termed *ngaviti* has been copied from a Nukuoro pattern.

Figure 48.—Baby in hammock.

Baby's Hammock

Hammocks for babies (*upena rikiana*) are in common use (fig. 48). They are formed of two parallel ropes tied at each end to suitable parts of the woodwork of the roof. A pandanus mat is folded from underneath over each rope so that the edges overlap. (In the old days, bark cloth, *mara kuru*, was spread on the folded mat and the baby placed on it.) The weight of the child fixes the

overlap and prevents the mat from unfolding. In addition, bandages of cloth are passed around the hammock and the child, at the level of the chest and the lower abdomen, and tied to prevent the child from falling out. A coir cord tied to the middle of the hammock enables the mother, even when working out in the back yard, to keep the hammock swinging from side to side. The babies like the swinging motion, which puts them to sleep. When not in use, the mat is detached but the cords may be left suspended.

The verb to swing is *upe*, and continued swinging is *upeupe*. Thus the noun *upena* applied to the hammock is derived from a different source than *upenga*, a net. The following sentence illustrates the use of the word, "Ti tinana e upeupe ti upena rikiana" (the mother is swinging the child's hammock).

PLAITING

INTRODUCTION

Plaiting is a craft which continues to be used in making so many useful objects of everyday life and the raw material provided by coconut and pandanus leaves is so abundant, that the craft will probably survive after other native crafts have given way to foreign introductions. Green coconut leaves provide articles of an expendable nature, or which are cast aside after their immediate use. Dried leaves are made into articles of more durable value. Pandanus leaves have a higher social rating, as they provide the material for various forms of mats of a higher grade than any made from coconut leaves.

Plaiting is essentially a women's craft, but men make coconut-leaf baskets out in the field when they need them for immediate use. Men also make the fishermen's conical cap of pandanus leaf, as it is associated with the male activity of fishing. The recently introduced type of belt made for trade is manufactured by both men and women.

The technique follows the general Polynesian pattern, in that the wefts run obliquely to the edges. The common Micronesian technique of running the wefts at right angles to the edges is not present. A type of green coconut-leaf basket and a four-cornered pandanus basket are late introductions. There are some local peculiarities, but these will be mentioned with the articles with which they are connected. As technique varies with the material used, it is more convenient to describe the various articles under the general headings of the materials, coconut and pandanus.

TERMINOLOGY

It is impossible to describe plaiting technique adequately without the aid of terms which have been accepted as the result of practical experience. Terms used in this section are defined as follows:

Weft: an individual strip of material used in plaiting.

Double weft: two individual strips, laid one on the other and plaited as a single element.

Dextral weft: a weft directed obliquely toward the right.

Sinistral weft: a weft directed obliquely toward the left.

Working edge: the oblique edge formed by the wefts which are alternately raised and lowered to enclose a crossing weft. In plaiting from left to right, the working edge is formed by dextrals and in plaiting from right to left, the working edge is formed by sinistrals.

Shed: the oblique space formed by raising one set of working wefts and lowering the other to provide the place for a crossing weft. Working dextrals provide the shed for crossing sinistrals, and working sinistrals provide it for crossing dextrals.

Check: each weft passes alternately over and under each consecutive crossing weft.

Twill: each weft passes over and under more than one crossing weft. In twilled twos, it passes over and under two crossing wefts; in twilled threes, over and under three crossing wefts. Combinations may be used with check, as threes and ones or with another twill as threes and twos.

COCONUT-LEAF ARTICLES

Coconut leaves are useful for making coarse articles quickly without preliminary treatment of material, for the leaflets form readymade wefts and their natural attachment to the leaf midrib obviates the necessity of fixing wefts at the commencement edge. The leaf midrib is split on one side with just enough thickness to support the leaflets required. The strip of leaf midrib thus forms the commencement, or near, edge when it is laid transversely before the craftswoman. However, the leaflets are all parallel in one oblique direction; consequently in the check plaiting which is used, alternate leaflets have to be bent in the opposite direction to provide the crossing wefts necessary in plaiting. The upper surface of the leaflets is a shiny green as compared with the duller color on the under side. Furthermore, the leaflets at their attachment to the leaf midrib form an inverted V with the leaflet midrib forming the upper apex. In changing the direction of the leaflets, it is more effective to press down the leaflet midrib and so open out the leaflet than to have the under surface of the leaflet uppermost. Hence, in plaiting with green coconut leaves, the true upper surface of the leaflets is kept uppermost. With this in mind, the leaflets from the left side of the leaf will form naturally directed dextrals and the alternate leaflets must be bent to the left to provide the sinistrals. On the other hand, a midrib strip from the right side of the leaf will carry naturally directed sinistrals and the alternate leaflets must be bent to the right to provide the dextrals. The naturally directed wefts are used to form the working edge. Thus, with a left hand strip, plaiting works from left to right with a working edge of natural dextrals; with a right hand strip, plaiting works from right to left with a working edge of natural sinistrals.

Platters and Containers

Articles made quickly on the spot from green leaves consist of five types bearing the general name of *poroporo* and specifically termed *poroporo hiki, poroporo hakaroi, poroporo hari kau, poroporo unga,* and *poroporo ha matu.* In addition, a type of basket termed *panunu* has been introduced from Nukuoro. An eyeshade shaped like a conical hat is also made. In these articles, the leaflet wefts are open to their full width and the plaiting is in check.

Though articles similar to some of the Kapingamarangi material have been described by me for Aitutaki (3, p. 163), Manihiki-Rakahanga (5, p. 115, pl. 3) and Samoa (4, p. 182), the technical details are given here to save students of the Micronesian area the trouble of seeking references which may not be available to them.

The *poroporo hiki,* the simplest form of *poroporo,* is a flat platter with a check technique. The Bishop Museum specimen (C.10087) is made from the split-off left side of the leaf midrib, cut to a length of 16 inches and carrying 11 leaflets which form natural dextrals. With the midrib strip forming the commencement edge and the shiny surface of the leaflets facing upward, plaiting commenced on the left with the three-leaflet commencement. The details are described below and shown in figure 49, *a-f.*

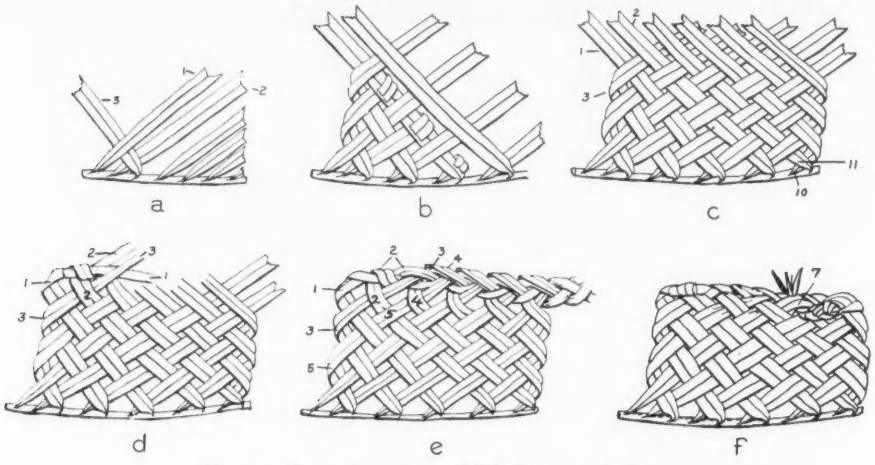

Figure 49.—*a-f, poroporo hiki* platter technique.

The third leaflet (*a,* 3) from the left end is bent to the left as a sinistral to cross over the second leaflet (2) and pass under the first leaflet (1). This is the general commencement with coconut leaf and will be referred to as the three-leaflet commencement.

From now on (*b*), the leaflets are dealt with in pairs, the one on the left remaining down as a dextral and the one on the right being bent to the left over it to form the sinistral. Following the check technique, alternate dextrals are raised to form the shed for the next sinistral. The figure shows three dextrals raised and four down to form the

shed in which the sinistral is placed. As the sinistrals reach the left margin, they are given a right-angled overturn to define the left edge and reenter the plaiting as functioning dextrals.

In *c*, when the plaiting reaches the right end of the midrib strip, the last dextral (10), after being crossed by the last sinistral (11), is bent with an overturn to the left to define the right edge and reenter the plaiting as a sinistral. This is continued upward for the depth of the plaiting. On the left upper corner the two sinistrals (1, 2) and the left dextral (3) will form the three commencement plies of the braid which will finish off the far edge of the platter.

In *d*, the left end sinistral (1) is turned in horizontally and twisted to reduce its width and form the first ply. The next sinistral (2) passes under the first ply and around it to form the second, outer ply. The nearest dextral (3) is lifted on the far side of the crossing sinistral (2) and crossed over the first ply to the middle position to form the third, inner ply.

From now on (*e*) the braiding is continued with the sinistrals passing under the braid and coming over from the outer side to join the outer plies and the dextrals entering the braid directly by joining the inner plies. Thus, after establishing the three-ply commencement in *d*, the next sinistral (4) passes under the braid and joins the outer ply (3) and the next dextral (5) enters the braid directly by joining the inner ply (1). This is continued at the right end; the braid is continued as a free tail. The end of the braid is tied in an overhand knot, doubled back, and the knot pushed through under a crossing weft (*f*, 7).

The completed platter is 14 inches wide and 9.5 inches long.

Though the plaiter usually selects the left side of the leaf to facilitate left-to-right plaiting, the right side is utilized when a number of platters are being made. With a strip of midrib from the right side of the leaf, the leaflets are natural sinistrals and the technique is the reverse of that shown in figure 49.

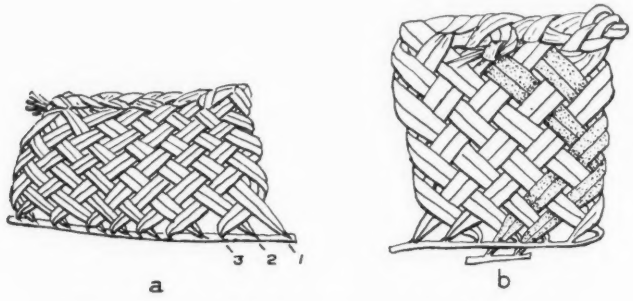

FIGURE 50.—*a*, right-hand platter; *b*, leaflet insert.

A right-hand platter (C.10086) with 15 leaflets is shown in figure 50, *a*. In the three-leaflet commencement on the right, the third leaflet (3) is bent as a dextral to pass over the second leaflet (2) and under the first (1). In the subsequent paired leaflets, the one on the left is bent as a dextral over the natural sinistral on its right. In plaiting, the natural sinistrals are lifted with the right hand to form the shed and the left hand bends back the leaflet midribs to form the dextrals which are laid in the shed. The side edges are formed

with overturns, and the finishing braid at the far edge commences on the right instead of the left. The dextrals, instead of the sinistrals, pass under the braid to enter from the far side as outer plies.

The two platters described were each made from one midrib strip which supplied all the leaflets required. However, in plaiting with one strip, the spaces between the wefts are sometimes too wide. This may be remedied by adding a shorter midrib strip to supply additional leaflets. To insert extra leaflets is termed *tui* as in the phrase "e tui ki kapi" (insert to fill in). The platter (C.10084) shown in figure 50, *b* is formed of a midrib strip 7 inches long with seven leaflets, and a short strip with two leaflets has been added to close up the inter-weft spaces. The platter is 7 inches wide and 10 inches long. Though the three-leaf commencement is shown on the left, it will be observed that the third leaflet passes under the second and over the first thus showing that the drawing depicts the under side of the platter which was plaited with a midrib strip from the right side of the leaf. However, it is the technical underside of the platter which is turned upward to receive the leaf package of food.

Flat coconut-leaf platters are made in the Cook Islands, where they are called *raurau*, the term applied to them in Nukuoro. Thus *poroporo* appears to be a later term which originated in Kapingamarangi.

The *poroporo hakaroi* differs from the *poroporo hiki* in being made as a deep dish to hold the *hakaroi* leaf packages. The type specimen in Bishop Museum (C.10088) is formed of a strip 7 inches long, with nine leaflets, and an insert 4 inches long with four leaflets. Both strips carry natural dextrals. The depth is obtained by forming two corners. Details are shown in figure 51 and described below.

As shown in *a*, plaiting begins on the left with the three-leaflet commencement. The insert is then placed on the near side of the main midrib strip and its four leaflets function as natural dextrals while the next four leaflets on the main strip are bent over them toward the left to form sinistrals. Of the last two leaflets on the right, the left one remains down as a natural dextral, and the one on the right is bent over it to form the right marginal sinistral. Unlike the *poroporo hiki*, the sinistrals which project beyond the left marginal dextral are not turned in to form the left edge and the dextrals projecting beyond the right marginal sinistral are not turned in to form the right edge.

The left corner is started, as shown in *b*, by turning in the third free sinistral (3) on the left to function as a dextral which passes through the other projecting sinistrals in check. Similarly the right corner is started by turning in the third free sinistral (3′) to function as a sinistral through the other projecting dextrals.

On the left, the next lower sinistral (*c*, 2) is bent round to enter the plaiting as a dextral. Then the lowest sinistral (1) is turned in a similar way. On the right, the lower dextrals (2′, 1′) are turned in a similar way to function as sinistrals. Above the long outer turns (1, 1′), two projecting wefts on each side are turned in with overturns to continue the left and right edges respectively. The far edge shows seven dextrals lying above the sinistrals, and these are used to form the first part of the braid finish.

The first two dextrals (*d*, 1, 2) on the left, which are drawn horizontally toward the right to form the first ply, pass under the two dextrals 5 and 6 which form the second

ply. The two intermediate wefts, 3 and 4, are drawn to the right as the third ply which passes over the second ply (5, 6) to the middle position. The first ply (1, 2) is now passed over the middle ply and takes with it the last dextral (7). From here on, the three plies are braided as a free tail which is knotted, turned back, and pushed through an interspace in the plaiting. The six sinistral wefts on the other side of the braid are simply cut off, but in other specimens, they are braided into a free tail, knotted, and pushed through an interspace.

Parts *a-d* are drawn on the flat but in actual plaiting, the corner wefts (*c*, 3, 3′) are pulled to form a bend in the surface of the plaiting, and pulling on the other two wefts to the outer side increases the bend and deepens the receptacle. Figure *e* shows the bend caused by these three wefts (1′ to 3′) on the right.

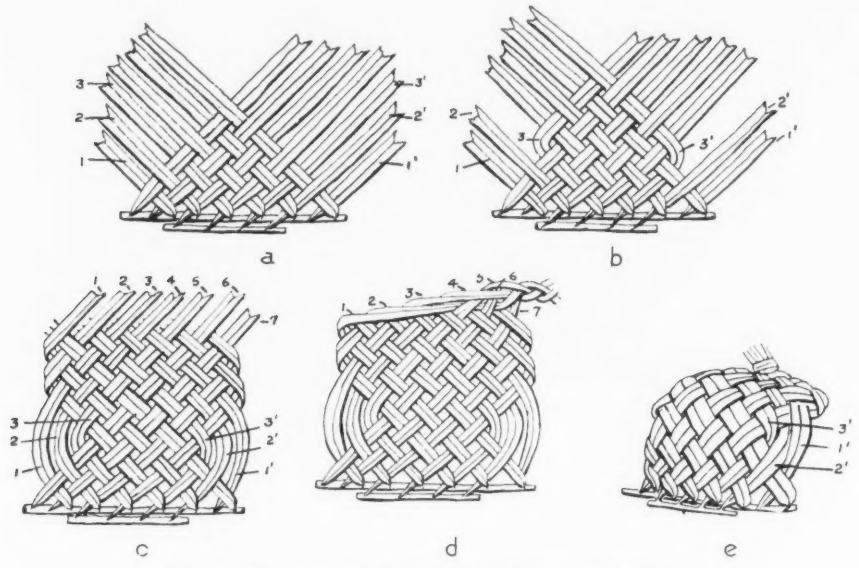

FIGURE 51.—*a-c, poroporo hakaroi* platter technique.

The *poroporo hari kau* is a form of field basket which has the same general uses as the satchel type of coconut-leaf basket in Polynesia. In the field, they are quickly made by men or by women. They are used to carry taro, *puraka*, and other foods, including fish from the outer islands and to bring in coral pieces for the oven, gravel for the floor, and sand for the roads. In the home, they form a receptacle for picking up fallen leaves and rubbish and may be used temporarily in the place of the better made round baskets. The name is derived from this general use, *hari kau* (to carry things).

A full section of leaf is used and the leaflets on each side are plaited as separate sheets. In the Bishop Museum specimen (C.10091), the midrib section is 2 feet 10 inches long with 17 leaflets on each side. The technique with open leaflets in check is shown in figure 52, *a-d* and described below.

Plaiting commences on the left side of the leaf with the three-leaflet commencement, and the working edge is built up to six dextrals, three up and three down (*a*). The free ends of the sinistrals are left projecting beyond the marginal first dextral (1) and similarly the ends of the dextrals are left free beyond the right marginal sinistral (2). However, a top sinistral on the left and a top dextral on the right may be doubled over the marginal wefts and passed under a crossing weft to prevent the ends from unraveling. Reversing the midrib, the right side having natural sinistrals, plaiting starts with the three-leaflet commencement on the right. The technique is the reverse of the left side in direction and in using sinistrals for the working edge but the result is similar.

The problem now is to join the two sheets together along the plaited edges which slope at the two ends. It is obvious that the free ends of the dextrals and the sinistrals run in opposite directions and look difficult to deal with as there are two sheets each with two divergent sets of free weft ends. However, if the midrib is placed end on to the plaiter, the two sets, instead of being right and left, are now directed toward the plaiter and away from her. The two-course braid finish so common in Polynesia is also used in Kapingamarangi in this rough form of basket. For ease of drawing and clarity of demonstration, the following figures are side views and the plaiter must be imagined as sitting at one end with the midrib end toward her.

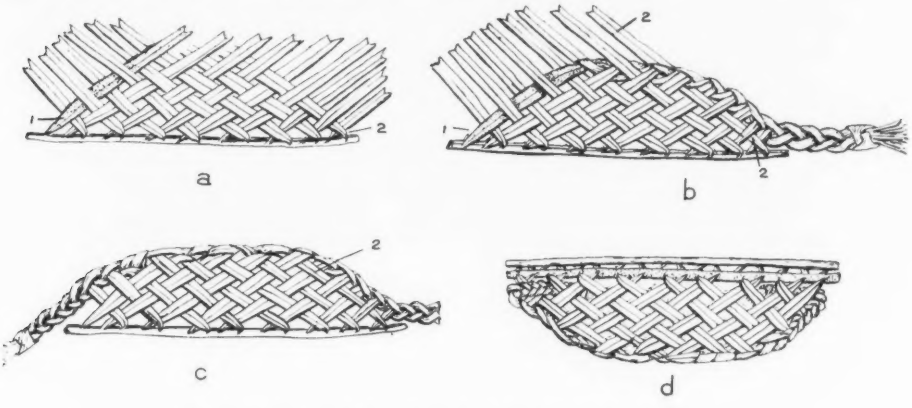

FIGURE 52.—*a-d, poroporo hari kau* basket technique.

In *b*, the plaiter is at the right end with the butt end of the midrib distal. She proceeds to plait the wefts directed toward her in a three-ply braid, commencing at the far end. It is obvious from *a* that the farthest weft inclined toward her is the weft which defines the far edge, which on the left sheet is the stippled first dextral (*a*, 1; *b*, 1). She accordingly picks up the far marginal weft of one sheet to form the first ply and the similar weft from the other sheet to form the second ply. The next weft directed toward her on the sheet of the first ply forms the third ply and braiding continues. The wefts are taken alternately from the two sheets and the wefts which are directed away from her are left out of the braid. When the braid passes the near or right marginal weft (*b*, 2), the braiding slopes downward and ends in a free tail, which is knotted.

In *c*, the ends are reversed and the plaiter is seated at the left end. The reversal changes the direction of the remaining wefts, which are now all directed toward the plaiter. Now, however, she has no trouble in selecting the farthest weft; but it is also the far marginal weft (2). The far marginal wefts from each sheet form the first two plies of the second course of braiding. Wefts are added alternately from each sheet, the braiding slants down on the near side of the near (left) marginal weft, and the second course ends in a free tail with an overhand knot.

In *d*, the plaiting is turned over and the leaf midrib split down the middle to form the rim on each side of the basket opening. The free tails at each end are doubled back into the basket and locked by passing the knots under crossing leaflets in the plaiting.

The *poroporo hari kau* has some affinity with the Cook Islands *tapora* (Hiroa, 3, p. 172). Both are made from a section of full leaf and each side is plaited separately as two sheets. In the *tapora* basket, however, the projecting ends at each end of the two sheets are plaited together to form continuous plaiting with the ends vertical. The bottom is closed with the two-course braid and the whole midrib is then split down the middle to form the two side rims. The *poroporo* thus forms a midway stage of the *tapora* technique but, though it is more quickly made and serves all practical purposes, it is not such a good container as the *tapora* type of basket.

The *poroporo unga* is made for collecting and carrying *unga* crabs to be used as bait in fishing. The technique is exactly the same as in the *poroporo hari kau*, but the leaf midrib is not split. The crabs are placed in the basket through the opening at one end near the midrib, and this opening is subsequently closed by doubling the braid end over it and pushing the knotted end through the plaiting from outside.

The *poroporo unga* is also a useful cage for transferring live stock such as fowls and ducks. King David was seen one day carrying this type of container to one of the outer islands. It was naturally thought that it contained hermit crabs for bait; but when he opened it the contents proved to be a live duck which he liberated on his poultry farm.

The *poroporo ha matu* is a special receptacle for carrying mature coconuts (*matu*) from the plantations to the homes. Some are made from a long length of coconut leaf, and, according to Hetata, some are large enough to carry 30 or 40 nuts. The load, slung on a pole, requires two strong men to carry it.

A full section of leaf is used with the leaflets on each side. The small sampler made by Hetata was divided into three sections by forcibly bending the midrib on the under side. The middle section supplied the plaited part and the two end sections, which had to have an equal number of leaflets, built up the sides by braiding with the free ends of the plaited middle section. Hetata's sampler has eight leaflets in the middle section and four at each end. This figure shows only one side of the leaf and a similar number on the outer side must be imagined. The details on one side of the section are shown in figure 53, *a*, *b*, described as follows.

In *a*, the eight leaflets of the middle part are plaited in check, and the ends are left free. The right section is bent upward at an obtuse angle. The free ends of the four dextrals on the right of the plaiting and the leaflets of the right section are joined by braiding from below upward. The lowest dextral (1) forms the first ply, the lowest right leaflet (2) crosses over it to form the second ply, and the next dextral (3) crosses over the second ply to form the third ply. Braiding continues with the leaflets on the right

entering the braid with the ply on that side, the other dextrals entering with the plies on the left side of the braid.

In *b*, the left section leaflets are braided with the four sinistrals of the plaiting in a way similar to that on the right. The ends of the braids are continued as free tails, then knotted together to form the braid loop through which the pole for carrying may be slipped.

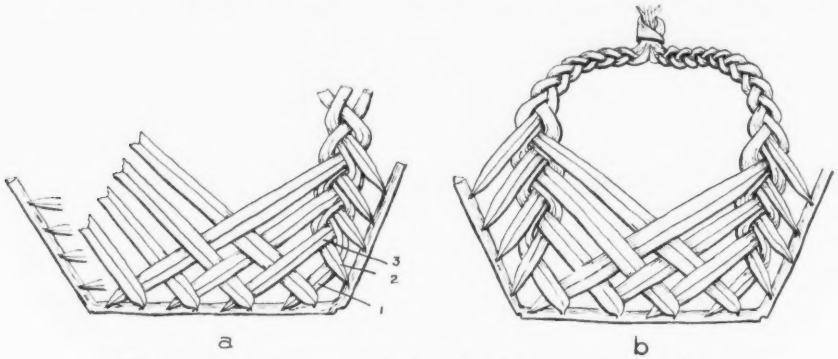

FIGURE 53.—*a*, *b*, coconut-leaf carrier (*poroporo ha matu*).

The leaflets on the other side of the leaf midrib are dealt with as in figure 53, and a second braid loop is formed for slipping over the carrying pole. Thus, a basket is made with the bottom and two slanting sides formed by the unsplit coconut-leaf midrib. The technique in the small sampler may be applied to any length of coconut leaf. The Kapingamarangi technique is a more developed process than that of a type of coconut leaf container made in the Polynesian atolls of Manihiki and Rakahanga (Hiroa, 5, p. 124, fig. 40).

HAT

A coconut-leaf hat (*kopai rauniu*) takes the place of the eyeshade so common throughout Polynesia. It is quickly made, by men, from a section of green leaf. In the demonstration specimen, a section of midrib bearing six leaflets on each side was cut off toward the tip end of the leaf. With the tip end of the midrib toward him and the under side of the leaf uppermost, the plaiter proceeded as shown in figure 54, *a-e* and described below.

In *a*, the leaflets which are directed toward the plaiter, have to be doubled back on their original course to provide crossing elements. Those on the left provide the dextrals and the working edge and those on the right, the sinistrals. Three alternate leaflets (1, 3, 5) are bent over obliquely as shown to provide the down dextrals of the working edge, and the other three (2, 4, 6) form the raised dextrals. The first leaflet (1′) on the right is bent over into the shed to provide the crossing sinistral.

The alternate set of left leaflets (*b*, 2, 4, 6) is doubled over the sinistral (1′) as down dextrals, and the other three are raised (cut off short in the figure) to provide the shed for the next sinistral (2′) which is doubled over from the right.

In *c*, the process continues until the six leaflets from the right have been included in the plaiting. The first two leaflets (1, 1′) form the side margins of the plaiting and the crossing of the last two (6, 6′) completes it.

In *d*, the midrib ends are reversed so that the free ends of the leaflets are toward the plaiter. Of the two marginal wefts, the under one (6) is doubled over the one (6′) above it, and turned back on its course, and fixed by a far crossing weft (2′) doubled over it and passed under the next crossing weft. The other marginal weft (6′) is then doubled over 6 to form the peak of the hat, and it is fixed by a crossing weft (3). The first two leaflets (1, 1′) are left long to form strings for the hat, and the others are doubled back over their respective marginal wefts and fixed by passing under crossing wefts. Some may be cut off.

A side view (*e*) shows the plaited front portion, the peak on the right, and the midrib with the back parts of the leaflets on the left.

This type of eyeshade is unique in shape, and may have been suggested by the fisherman's conical hat made of pandanus leaf (fig. 76, *c*, *d*).

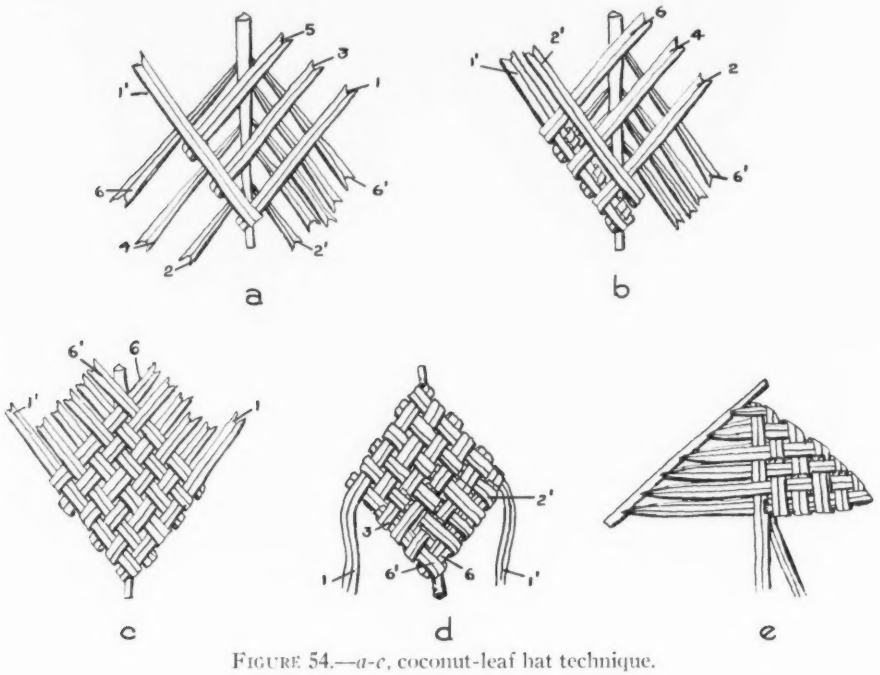

FIGURE 54.—*a-c*, coconut-leaf hat technique.

THATCH

Coconut-leaf sheets (*kauramarama*) are used to thatch cooking houses, houses used in connection with *puraka* cultivations or fishing expeditions in the outer islands, and some canoe sheds. The term *rou niu* (coconut leaf) is not applied to the thatch sheets, as that term would imply that the sheet is made of green leaves fresh from the tree, whereas for thatch sheets, the green leaves are first soaked in the lagoon until they turn brown. The sheets are then plaited and exposed to the sun to dry. Bundles of thatch sheets are seen drying out in

the open or stacked in storehouses or on the beam platforms (*hata*) of the canoe houses. Here they remain, while the other material for the house is being assembled. In the term, *kauramarama*, the repetition of *rama* distinguishes the coconut-leaf sheet from the superior thatch sheets made of pandanus leaves and termed *kaurama*.

In olden times, the coconut leaflets on each side of the leaf midrib were plaited as two distinct sheets and the midrib split afterward to separate them. In thatching, two single sheets were overlapped and tied to the framework as one sheet. In later times, a new technique has been introduced from Nukuoro in which two sheets plaited on one midrib are joined together by double plaiting the end leaflets and also the leaflets at the far edge. The advantage of this method is that the double plaiting of the far edge, which becomes the lower edge when thatched, cannot be separated by the wind, whereas with two single sheets, the wind often blew up the lower edge of the outer sheet and admitted rain. Kapingamarangi people acknowledge the superiority of the Nukuoro technique, and it has been generally adopted, though single sheets in pairs are still used at times. The introduction of the new style cannot have been so long ago, for even the younger people know about the general use of the older style.

In plaiting single sheets, with a full leaf, the under side of the midrib is turned outward and the left side of the leaf turned upward with the midrib butt end to the left. The plaiting of the left side is shown in figure 55 *a*, and described as follows:

As the leaflets form natural dextrals, plaiting commences on the left end with the three-leaflet commencement. The first sinistral (3) on meeting the left edge is turned in with an overturn to define the left edge, and the next sinistral (4) is treated similarly. When a working edge of six dextrals is reached, the end sinistral (5) is doubled back and the doubled end pushed under the nearest crossing dextral (1), which locks the left edge. Plaiting proceeds to the right end of the leaf section, where the right edge is formed by turning back the projecting dextrals (1′, 2′) and the free dextral end (3′) is doubled back under a crossing weft to lock the right edge. This completes the sheet, for the ends of the dextrals and sinistrals at the far edge are left free.

The other side of the leaf is turned up and, as the natural wefts are now sinistrals, plaiting commences at the right end with the three-leaflet commencement and the sinistrals forming the working edge. The side edges are turned in and locked as with the other sheet.

The leaf midrib is split down the middle to separate the two sheets, which, however, have their midrib edges placed together above when laid on the thatch rafters so that the cord passes around both in lashing.

The double thatch sheet is plaited in exactly the same way as the single sheets.

The left side of the leaf with the natural dextrals (fig. 55, *a*) is plaited first, then the other side with the natural sinistrals. The leaflets projecting at the right and left ends are not turned to define the edges, but are left free. These oblique ends, however, are temporarily locked by breaking the leaflet midrib of one crossing weft and hooking it over the leaflet midrib of the other crossing weft.

With the right plaited side uppermost, the ends of the two sheets are joined (fig. 55, *b*). Commencing on the right, the free dextral ends of both sheets projecting beyond the marginal sinistral (1′) are combined as double wefts and plaited in the same way as a single sheet. The lowest double dextral (1) is turned in with an overturn to pass over and under the crossing dextrals in check, and the next projecting dextral (2) is treated in a similar way. The dextral (4) is picked up as a double weft and the under weft is twisted around the end double dextral (3) in a half-hitch. The original end sinistral (1′) is picked up beyond the second crossing dextral (4) from the midrib, and the under leaflet is picked up with it to form a double weft. The crossing dextral (6) of the upper sheet is raised and dropped over the double sinistral (1′), which is thereby enclosed between the dextrals of the upper and lower sheets. This technique is continued toward the left, as shown by the stippled parts of the double sinistrals. At the left end, the free ends of the sinistrals of both sheets projecting beyond the marginal dextral (21) are plaited as double wefts in check, and a half-hitch is made around the end sinistral (16) as shown.

The two sheets are now united at the ends and the far (lower) edges, and the midrib is not split.

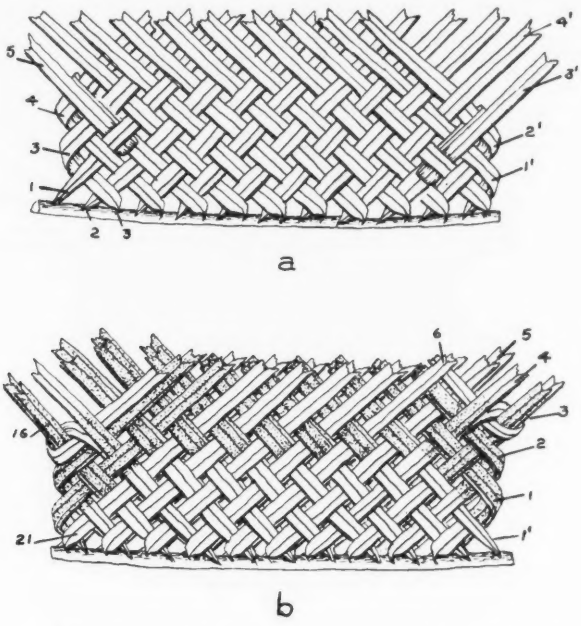

FIGURE 55.—Coconut-leaf thatch sheets: *a*, single; *b*, double.

OVEN COVER

Oven covers (*tanga imu*), plaited from coconut leaf, are used to cover food before dirt is scraped over the oven to seal it. They are made from a section of leaf about 18 inches long which is split down the leaf midrib into halves. The halves are placed together transversely before the plaiter, with the midrib strips toward her. The upper sheet is from the left side of the leaf and its leaflets,

directed toward the right, form natural dextrals. The under sheet from the right side of the leaf provides naturally directed sinistrals. As the two sheets provide crossing leaflets, there is no need to bend alternate leaflets in the opposite directions such as had to be done with the single sheets in the *poroporo* platters and the thatch sheets. In the single sheets, the leaflets are opened out to their full width to fill in the wider interspaces caused by bending alternate leaflets in the opposite direction. In the two-sheet technique, it is not necessary to open out the leaflets, hence the oven covers are more durable.

In another advance in technique, the dextrals and the sinistrals cross over and under two crossing wefts to form twilled-twos after a commencement row of single crossings or checks. As single crossings are characteristic of the *poroporo* articles, a check plait is termed *ara poroporo*. Twilled plaiting is distinguished by the term *ara herengaua*.

In the thatch sheets, the ends of the leaflets at the finishing edge are left free because they make a smoother surface on the stationary thatch, but articles which are handled are braided at the far edge to prevent unraveling. It is probable that the braid finish of oven covers was originally like that of the *poroporo* platters (fig. 49), in which the two sets of leaflet ends run in opposite directions before they are immediately incorporated into the braid. The Kapingamarangi people, however, have developed or borrowed an additional technique by which the two sets of leaflets are made to run in one direction before braiding is commenced. The various processes mentioned are described in detail because new technical details are introduced.

The commencement, the twilled technique, and the braid finish are shown in figure 56 and described below.

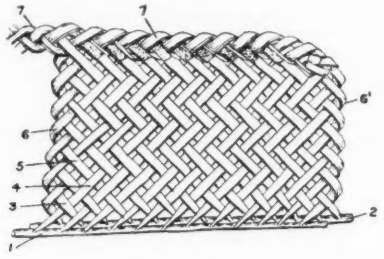

FIGURE 56.—Oven cover.

The dextral midrib strip (1) is shown above the sinistral strip (2). The sinistrals are lifted up from below and crossed over single dextrals to form a horizontal row in check (3). The working shed is formed of dextrals which are raised in alternate pairs to form twilled-two plaiting. As each new shed is formed on the right, the far weft of each raised pair is dropped and a down dextral is picked up on the near side. The working shed of two up and two down is maintained throughout. The filling of the raised pairs from the near side causes the alternate rows of two dextrals (4) and two

sinistrals (5) to move horizontally across the plaiting. The side edges are formed by turning in the wefts with an overhand turn (6, 6′) at right angles to cross over the weft on its far side. The twilled-two plaiting continues for a depth of about 20 inches and ends with the dextral wefts above the sinistrals. The final process consists of the braid finish (7).

During the commencement process, single leaflets torn from an extra piece of leaf, may be inserted (*tui*) as extra dextrals or sinistrals whenever the space between adjoining wefts from the midrib strips becomes too wide.

Before the far edge of the plaiting is fixed by braiding, the free ends of the dextral wefts are changed in their course so as to run in the same line as the sinistrals. Commencing on the left end, the procedure is shown in figure 57, *a-f*, described below.

In *a*, wefts 1-3 are dextrals and 1′-3′ are sinistrals. The object is to commence with the first or end dextral (1) and change its direction to turn downward on the second sinistral (2′). The second dextral (*b*, 2) is doubled back over the crossing sinistral (1′). The first dextral (*c*, 1) is bent down at right angles with an under turn to lie on the second sinistral (2′). The second dextral (*d*, 2) is straightened out over the double weft (1, 2′) and fixes the first dextral in position. The technique is continued (*e*) by turning down the dextral 2 on the sinistral 3′, the dextral 3 on the sinistral 4′, and so on to the right end of the free edge.

In the next process (*f*), when the braid is being plaited, the downward-directed dextrals are doubled back over the top crossing dextral for inclusion in the braid. Thus the downward-directed dextral 1, is doubled back over the top crossing dextral 2. This technique applies to all the turned-down dextrals.

The three-ply braid finish of the far edge is commenced on the right. After establishing the first three plies, the free ends of the sinistrals are brought over to enter the distal plies of the braid and the turned-down dextrals are doubled back over the top crossing dextrals to enter the near plies as shown in figure 57, *f*. The technique is shown in figure 57, *g-l* and described below.

In *g*, the right end of the plaiting edge with the turned-down dextrals is stippled and the free ends cut short to save space on the drawing. The three wefts to commence the braid are the two last dextrals (1, 2) not turned down and the last turned-down dextral (3). The end dextral (*h*, 1) is turned to the left, the next (2) is turned down over it, and the turned-down dextral (3) is crossed over the dextral 2, thus forming the three commencement plies of the braid. The first ply (*i*, 1) is lifted and the third ply (3) is turned up under it to lie on the second sinistral (5). The first ply (1) is dropped over it, and the turned-down dextral (6) is doubled back over it. Then the second ply (2) is also turned upward so that the three wefts (3, 6, 2) lie in the direction of the second sinistral (5). The first sinistral (*j*, 4) is turned in as a far weft to cross the composite ply lying on the second dextral (5). The original first ply (1) is turned up over the first sinistral (4) and the turned-down dextral lying on the next sinistral (7) is turned up to form a near ply crossing the far ply (4). The composite ply with the second sinistral (*k*, 5) is crossed over as a far ply and the ply formed by the sinistral 4 is turned up as a near ply with the turned-down dextral to cross and lie on the next sinistral 8. In *l*, the far and near plies having been established, the braiding goes on with the sinistrals covering the far plies and the turned-down dextrals doubled back over the near plies.

The braiding is continued to the left end and carried on as a free braid or tail (fig. 56, 7), which is knotted, doubled back, and the knotted end passed through beneath a crossing weft on the plaited part.

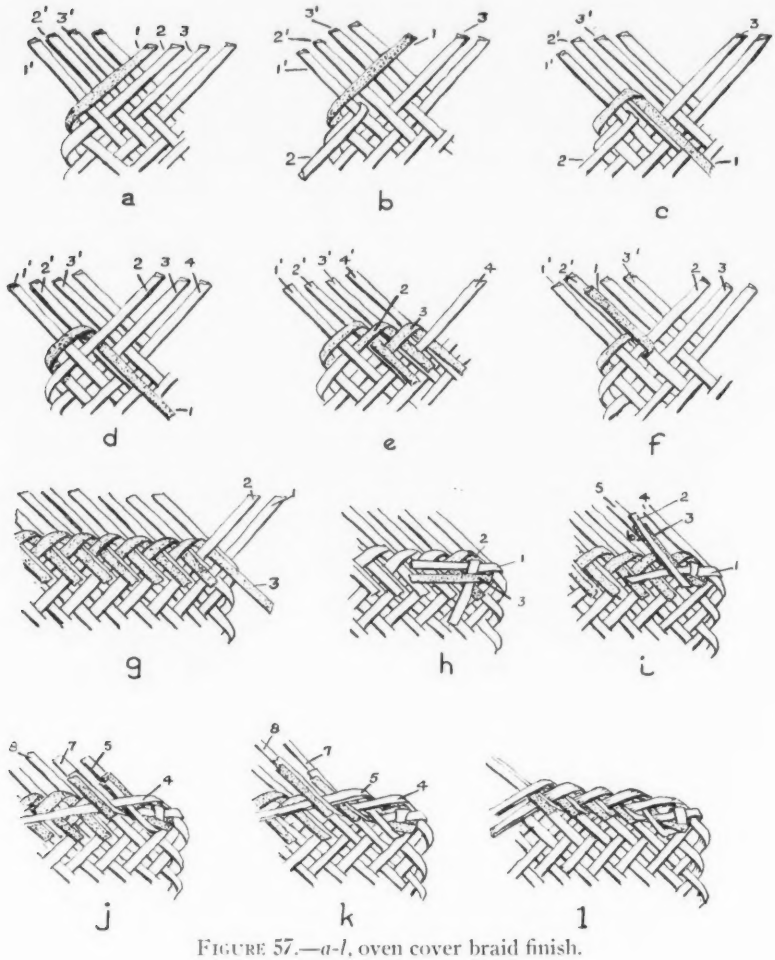

FIGURE 57.—*a-l*, oven cover braid finish.

FLOOR MATS

Two types of floor mats are made from coconut leaves which, like the leaves for thatch sheets, are soaked in the lagoon and then dried in the sun. To make them more lasting, the oven cover technique of closed leaflets is used and also the twilled plait. As in the oven covers, extra single leaflets are inserted (*tui*) whenever the space between adjoining wefts becomes too wide.

The two types, *tapakau* and *hinai*, differ in that the *tapakau* has midrib strips down the middle and the side edges are braided, whereas the *hinai* has whole midribs on the side edges and a braid join down the middle. These mats are in everyday use on floors and outside for people to sit on or place articles

upon. They are also used as wall screens to prevent drafts or to insure privacy.

The *tapakau* mat plaited by King David's wife, Reora, was composed of four half leaves each 7 feet long. The four midrib strips were arranged lengthwise and close together, the first two on the left forming the two sides of a natural leaf, the other two on the right forming another natural leaf. Counting from the left, the first and third strips had their leaflets directed toward the left and the second and fourth strips had theirs directed toward the right. Thus, the first and third strips supplied the leaflets for the mat on the left side and the second and fourth strips, the leaflets for the mat on the right.

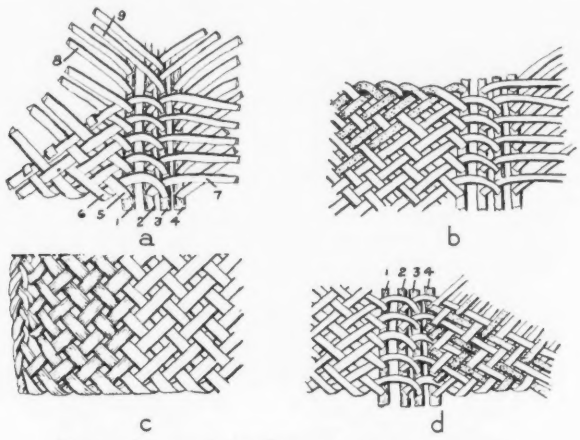

FIGURE 58.—*a-d, tapakau* mat, commencement.

In placing the midrib strips close together, the outer midrib on each side was placed on top of the leaflets of the inner strips. Thus, as the leaflets of the inner strips were required they were picked up from below to enter the plaiting. Plaiting commenced with the left sheet and proceeded longitudinally with the leaflets of strip one forming a sinistral working edge, the leaflets from strip three being bent over the midribs of strips two and one to enter the working shed. The technique is shown in figure 58, *a-d,* described below.

The four midrib strips (*a,* 1-4) are shown in position. The near leaflet (5) of strip one is raised to form the first working sinistral. The corresponding leaflet (6) of strip three is raised; but before it passes across to the left, the corresponding near leaflet (7) of strip two is passed under it toward the right to take up its position with the leaflets of strip four for the subsequent plaiting of the right sheet. The leaflet (6) of strip three now passes over the two midrib strips on its left to pass under the raised sinistral (5) of strip one. The crossing of the leaflets from strips two and three locks the two middle midrib strips together and forms the join between the two halves of the mat.

Working forward, the leaflets of strip three are successively raised, the corresponding leaflets of strip two passed under them to the right, and the raised leaflets of strip three cross the two left midribs and enter the shed provided by the leaflets of strip one. Leaflet 6, after crossing under the sinistral (5), is bent in with an overturn to define the near

edge and reenter the plaiting, and the other leaflets follow suit. A working edge is built up of ones and twos, but it may consist of threes and ones, or whatever combination pleases the plaiter. In the working shed shown, the first raised sinistral is leaflet 8, and the crossing weft to be laid in the shed is leaflet 9. With this twilled working edge, the plaiting proceeds for the full length of the midrib strips.

In *b*, the projecting free ends are turned back into the plaiting to form the far edge, as shown by the stippled wefts, when the twilled plaiting reaches the far end of the midrib strips. They are bent around without being doubled over as in the near edge.

As shown in *c*, the twilled pattern (*ara herengaua*) extends out for about 10 inches from the midrib strip. Then the plaiting is changed to a check (*ara poroporo*), as shown by the shaded wefts. The check pattern is continued for a lateral depth of about 8 inches, and the side edge is completed with a three-ply braid in the same way as the *poroporo* platters. The braid finish, termed *tari*, is commenced at the near end and finished at the far end with a free tail, which is knotted and turned back on the under surface of the mat to be caught under a crossing weft.

As figure 58, *b* shows, the right side of the mat is then plaited in a similar way to the left side; the leaflets from strip two, having already crossed under those of strip three, are crossed over the two midrib strips on the right and passed under the leaflets of strip four to enter the plaiting as shown. Single leaflets torn from an extra leaf are inserted (*tui*) to fill in the wide spaces when they occur between the midrib leaflets. They are simply laid over the fourth midrib strip, as shown by the stippled wefts.

The right side is finished at the far edge and braided at the side edge in the same manner as the left sheet.

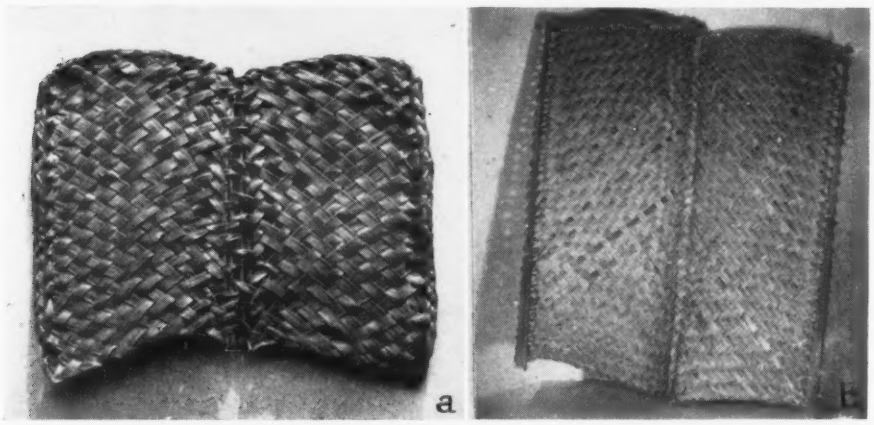

FIGURE 59.—Coconut-leaf mats: *a, tapakau; b, hinai.*

In figure 58, *a*, no inserted wefts are shown, lest the fundamental technique be confused, but in practice they are inserted as shown in figure 58, *d*.

A small *tapakau* mat made for the Museum as an example of a priest's sitting mat (C.10018) is 13.5 inches long and 18 inches wide, and the technique is the same as that of the large mats (fig. 59, *a*).

The *tapakau* type of mat is made in Samoa with four midrib strips, two from each side of the leaf. The near and far ends are turned and the side edges braided, as in the Kapingamarangi mat. It differs, however, in the arrangement

of the four strips, the strips from the same side of the leaf being paired instead of placed alternately. The pair from the left side of the leaf is placed on the right and the pair from the right is placed on the left. Leaflets from each strip of a pair are crossed alternately throughout the length of the strips in their natural direction so as to clear the way for plaiting and to lock the pairs together. The Samoan technique is simpler but not so neat (Hiroa, 4, p. 210).

It is significant that, though the Samoan name now in general use is *polavai*, the mat was once called *tapa'au*, in which the glottal stop represents the *k* of the Kapingamarangi and other Polynesian dialects. The archaic term of *tapa'au* was formerly applied to the mats upon which the gods were placed during religious ceremonies. Thus the gods sat on the *tapa'au* mat in Samoa, whereas in Kapingamarangi, the human representatives of the gods sat on the *tapakau* mat. The technique, name, and a specialized function in Samoa and Kapingamarangi bear evidence of some common source from which diffusion took place.

Hinai mats are in more general use than the *tapakau*, probably because of their stiff midrib side edges, which make it possible to prop them up as screens for the sides of the houses. They are made from two whole sections of leaf about 6 or 7 feet long. The sections are plaited on opposite sides of the midrib to provide two half sheets. A half sheet is termed a *rau hinai*, the complete mat with the two halves braided down the middle, a *hinai*. In plaiting, the leaf section is laid lengthwise with the wider under surface of the midrib uppermost and the butt end toward the worker. The commencement of the right half sheet is shown in figure 60, *a-c*, described as follows.

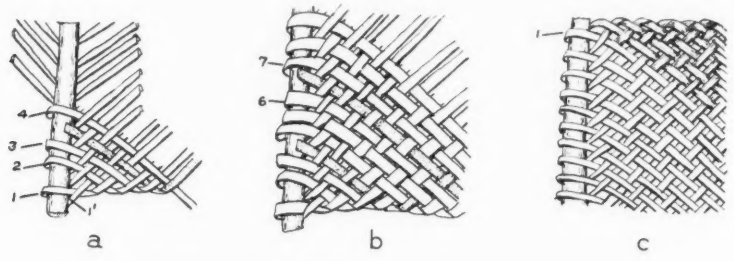

FIGURE 60.—*a-c*, *hinai* mat, commencement.

As shown in *a*, the naturally directed leaflets on the right provide the working edge and the leaflets on the left are bent across the midrib to engage as crossing wefts. Though the working wefts are dextrals from their direction, the crossing wefts also incline toward the right, and it will be less confusing in longitudinal plaiting to refer to them as right and left wefts instead of dextrals and sinistrals. The first right weft (1') in the figure is an extra without a paired leaflet on the left. This weft (1') is raised and the first left (1) is brought across the midrib to pass under it. The second left (2) is brought over, passes under the second right and over the first right (1) in check. The free end of the first left (1) is given an under-turn to pass over the second left (2) and run

parallel with the first right (1′). The under-turn of the first left defines the commencement of the near edge and the succeeding wefts follow suit. Above the third left (3), the space between it and the next left (4) is too wide, and an extra crossing weft (stippled) is inserted (*tui*). The pattern at the commencement is somewhat irregular; but the ultimate object is to build up a working edge of twilled twos and ones, the working edge having a sequence of one up and two down.

In *b*, the continuation of the plaiting shows the general pattern of twilled twos and checks, though an occasional twilled three creeps in to adjust the pattern. Between the two lefts, 6 and 7, the space widens again and an extra weft (stippled) is inserted to close the space.

In *c*, the working edge proceeds to the far end of the leaf section when the far edge is formed by turning back the end wefts with an underturn, as shown by the stippled wefts which project beyond the last crossing weft (1).

The twilled technique (*ara herengaua*) extends outward from the midrib for 13 inches. The twill may be in twos or threes usually separated by a check. After the twill, comes a 5-inch width of plaiting in check (*ara poroporo*). The right free edge of the plaiting is left with the leaflet ends projecting free, but crossing leaflets are pinned at each end with the broken leaflet midrib of one of the pairs. This completes the right half sheet.

The second half sheet is plaited on the left side of the midrib so that the naturally directed left leaflets provide the working edge and shed and the right leaflets are brought across the midrib to provide the crossing wefts. The technique in all details is similar to that of the right sheet, but in reverse.

Before the two sheets are joined, a special technique is used to make the two sets of crossing leaflets at the side edges run in one direction as double wefts. The sheet is laid transversely before the plaiter; and in this position, the wefts may be referred to as dextrals and sinistrals. The technique of the left sheet (fig. 61, *a-i*) and the reverse process (*j-l*) are described below.

In *a* is shown the left end of the free edge with sinistrals (1-3) and dextrals (1′-3′). The first dextral (*b*, 1′) is to have its course changed to form a double weft with the second sinistral (2). The two dextrals (2′, 3′) below the first are raised and turned back and the second sinistral (2) is doubled back over the crossing dextral (4′). The first dextral (*c*, 1′) is given an over-turn and directed downward in the prepared shed. The lower of the raised dextrals (*d*, 3′) is straightened out over the weft in the shed (1′). The dextral in the shed (*e*, 1′) is doubled back over the crossing weft (3′) and so changes direction permanently. The turned back sinistral (*f*, 2) is straightened out to resume its normal course, but it now lies on the converted dextral (1′) as a double weft. The upper turned-back dextral (*g*, 2′) is straightened out to cross the double weft formed by the previous top dextral (1′) and the second sinistral (2). The first sinistral (1) remains as a single. The upper free dextral (*h*, 2′) and the next sinistral (3) must now be paired. The two dextrals (3′, 4′) below the top one (2′) are turned back to form the shed, and the next sinistral (3) is doubled back over its own course. The position is now the same as in *b*, and the successive steps from *c* to *g* are repeated. In *i*, the conversion of dextrals into sinistrals continues to the right end of the plaiting, but the technique cannot be applied to the last dextral (0′) and the last sinistral (0), so they remain as singles.

The right sheet is treated in a similar way to the left sheet, but in reverse. With the midrib laid crosswise and the butt end to the right, the plaiting commences at the

right end and works to the left. The sinistrals are used to form the working edge, and the technique is directed toward changing their course to be overlapped by the dextrals and so form double dextrals.

In the reverse process, *j*, corresponds to *b*, but the two sinistrals (*2'*, *3'*) are turned back to form the shed, and the second dextral (*2*) is doubled back on its course over a crossing sinistral (*4'*). And *k* corresponds to *c*. The top sinistral (*1'*) has been turned into the shed with an over-turn, the lower of the turned-back sinistrals (*3'*) crossed over it, and the top sinistral (*1'*) doubled back over it in a dextral direction. And *l* is like the process in *i*, except for the straightening out of the turned-back second dextral (*2*) over the doubled back first sinistral (*1'*), and crossing the remaining raised sinistral (*2'*) over what is now a double dextral weft. The process is continued until all the sinistrals have joined the dextrals to form double dextrals.

Thus, the left sheet has a long side edge of double sinistrals and the right sheet has an edge of double dextrals.

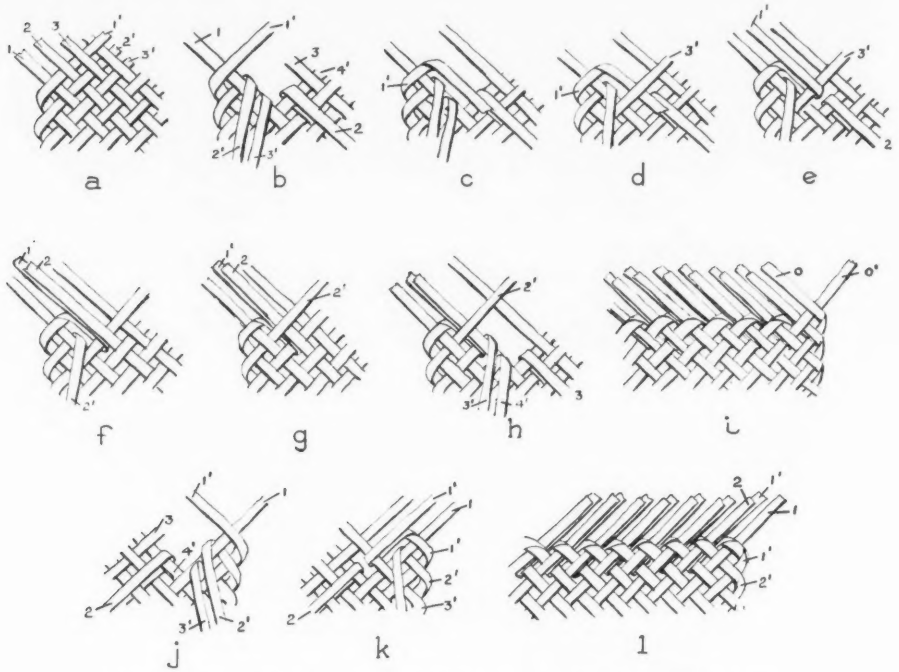

FIGURE 61.—*Hinai* mat, finishing edge: *a-i*, left sheet; *j-l*, right sheet.

The next process is joining (*tutaki*) the two sheets. They are placed together lengthwise with their midrib edges outside and the free leaflet edges together in the middle line. What was the right sheet in construction is now on the left, and its free leaflet ends overlap those of the sheet on the right. The braiding of the double wefts commenced at the far end and, with the exception of two end leaflets, all are inclined toward the plaiter. Thus by using double wefts, the joining braid can be completed in one course. For technique, see figure 62, *a-e*, and the following description.

As shown in *a*, the far end of the two sheets shows the left leaflets overlapping those of the right sheet. The two end singles (3, 3′) projecting outward and the other two singles (1, 2) bent inward, provide the first three plies of the braid commencement. The right single (*b*, 1) is lifted up from below the left sheet to form the first ply, the left single (2) crosses over it to form the second ply, and the two outward singles (3, 3′) are twisted together to form the third ply.

The third ply (*c*, 3) is bent down into the middle position between the first and second plies. The first ply (1) is brought over from the left across the third ply (3) into the middle position and the second ply (2) is crossed over it from the right into the middle position.

The first right double weft (*d*, 4), which is now on the left, is doubled over with the left ply (3) into the middle, and the first left double weft (5) which is on the right, is doubled over into the middle with right ply (1). As shown in *c*, the double wefts now enter the braid alternately from the left and right with the braid ply of those sides. The figure is taken from the actual specimen in which the wefts are close together and not spaced apart as in the preceding figures.

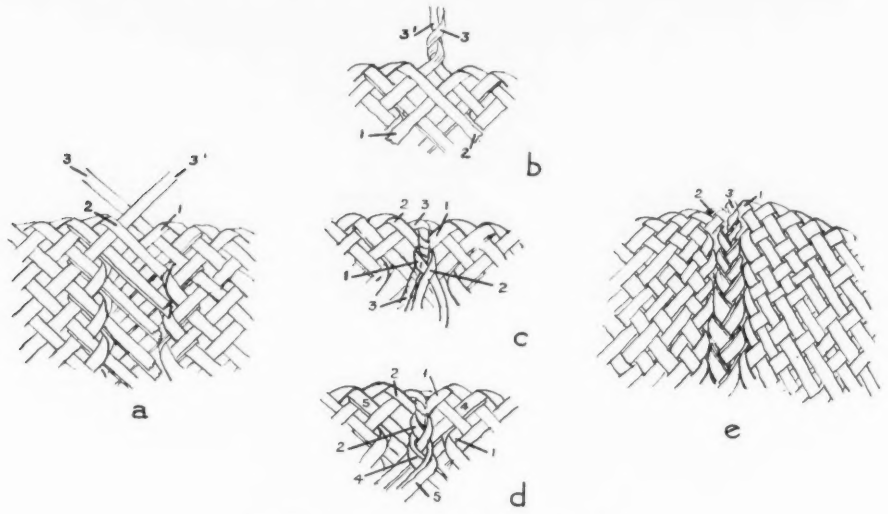

FIGURE 62.—*a-c*, *hinai* mat, braid finish.

It will be noted that, because the wefts are crossed in the middle line (fig. 62, *a*), they cross under the braid and are doubled back into it from the opposite side. The wefts from the left sheet enter the braid from the right, and those of the right sheet enter from the left. The braid is continued to the end of the two sheets, and wefts are dropped from the plies at intervals to prevent the braid from becoming too thick. At the near end, the braid is continued as a free tail, knotted, and doubled back on the under surface to be held by insertion between crossing wefts. Thus, the two half sheets are joined together by a median braid and, like the *tapakau* mat, the *hinai* mat is twice the width a coconut leaf would normally provide. The specimen in Bishop Museum (C.9976) is a sampler 30 inches long and 25 inches wide. (See figure 59, *b*.)

Mats of the *hinai* type are made as carrying sheets in Samoa and as house screens in the Cook Islands (Hiroa, 4, pp. 172-175; 3, p. 32). There are these differences, however: the half sheets are plaited from split half leaves with open leaflets and the median braid is made in two courses like the bottom of the *poroporo hari kau* (fig. 52). Kapingamarangi mats are much superior and more durable because they are made with closed leaflets derived from both sides of an unsplit midrib section. The technique of forming double wefts running in one direction and hence making the median braid in one course is not found in Polynesia, so far as I know.

Round Basket

A round basket made from green coconut leaves dried in the sun bears the western Polynesian name of *kata*. The specimen demonstrated for me was made of two midrib strips, each 50 inches long. They were split off from each side of the leaf with just enough midrib to carry the leaflets. Commencing at the right end, each of the leaflets on the strip bearing the sinistrals was twined over the next leaflet on the left in sequence so that a twined appearance was produced (fig. 63, *a*). This, however, did not change the direction of the leaflets. The dextral leaflets of the other strip were not twined. The two strips were placed together crosswise with the sinistral strip on the upper side. The sinistrals from the upper strip were used to form the working shed, and plaiting with closed leaflets commenced on the right. The naturally directed dextrals were picked up from the strip beneath to lay in the working shed; and with two sets of leaflets from opposite sides of the leaf, there was no need to provide crossing elements by bending. The use of two strips not only rendered plaiting easier, but allowed the use of closed leaflets to make a stronger basket. The sinistral shed from the midrib outward was formed of one up, one down, and two up. This established the first two rows in check and the third in a twilled-two.

When the plaiting reached the left end, a dextral shed in twilled-twos was built up and the next section of plaiting moved from left to right in twilled-twos. No side edges were formed at either end, and the dextrals which projected beyond the first sinistral on the right and the sinistrals which projected beyond the last dextral on the left were left free instead of being turned back into the plaiting. A third set of twilled-twos was worked from right to left and a single row of twilled twos from left to right. The method of plaiting sections alternately from each end differs from the general Polynesian technique in which succeeding sections are usually plaited from the same end as the commencement section, though the Hawaiians sometimes alternated in pandanus mats.

The depth of the plaiting having been attained, the next problem was to join the two midrib ends together and fill in the gap between the divergent oblique ends of the plaited band. For the technique described below see figure 63, *a*, *b*.

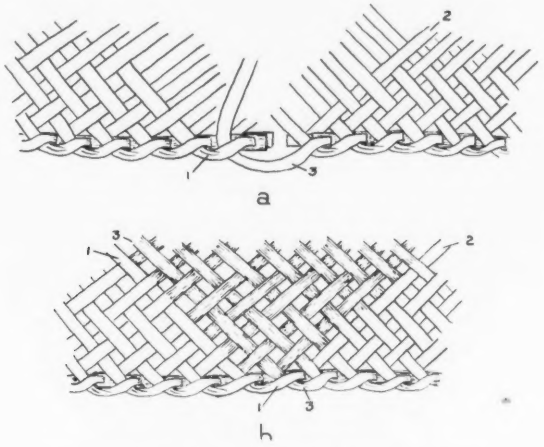

FIGURE 63.—*a*, *b*, round basket, commencement.

In *a*, the two ends of the midrib are brought together so that the original right end is on the left, the left end on the right. The first sinistral (1) on the left marks the oblique end of the plaiting, and the last dextral (2) on the right defines the edge of the plaiting on that side. The last sinistral (3) on the right, which is free, is passed under the twined loop made by the first sinistral (1) on the left and drawn taut to lock the two midrib ends together. The dextral wefts come from the inner midrib strip which is concealed by the outer sinistral strip. The ends of the dextral strip merely overlap, for the locking of the outer sinistral strip and the subsequent plaiting are quite sufficient to secure the join.

In *b*, the tautening of the sinistral (3) makes the twined edge continuous, and it enters the plaiting as a functioning sinistral. The sinistrals from the right oblique edge and the dextrals from the left edge are plaited together with the same design as the rest of the plaiting, as shown by the shaded wefts. The plaiting is continued to the established depth, and the circular band of plaiting to form the sides of the basket is completed.

The next step was to form the circular bottom of the basket. In the last row of plaiting, the dextrals were above and the sinistrals were pushed down into the interior of the plaited cylinder, leaving a fringe of dextrals around the circular edge of the plaiting which rests with the twined rim on the ground. Each dextral was forcibly pulled (*huti*) inward for the whole round to change direction from the vertical sides to the horizontal bottom. A row of plaiting was made around the circular opening, two dextrals being combined as double wefts, and two corresponding sinistrals were drawn up successively from below to form double wefts to cross with the dextrals. After each crossing, the sinistral wefts were again pushed down to be out of the way. On completing

the round, the fringe of double dextrals was again forcibly pulled in sequence and the opening materially reduced in size.

The plaiting continued in complete rounds of one crossing of dextrals and sinistrals, the sinistrals being picked up from below and pushed down again after each stroke. At the end of each round, each dextral was forcibly pulled inward to tighten up the plaiting and reduce the size of the opening. The technique of closing in the bottom and the final closure of the opening are illustrated by figure 64, *a, b,* described below.

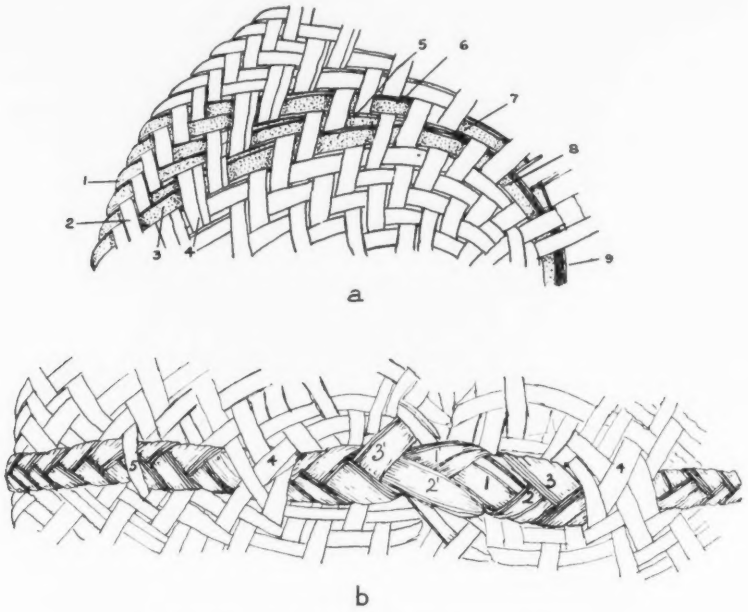

FIGURE 64.—*a, b,* round basket, bottom closure.

As shown in *a,* the plaiting throughout continues in twilled-twos. The outer circumferential row (1) consists of sinistrals of which six are stippled. The next row (2) consists of dextrals which have been pulled inward to start the bottom surface. The sinistrals (3) are then picked up in pairs and crossed by pairs of dextrals (4). What subsequently happens is shown by the stippled sinistrals. In the next round, the paired wefts which were slightly apart, are overlapped as single wefts (5). The double wefts (6) approach each other in the next round and two pass under the same crossing dextral. In the next round, the two pairs overlap as a single fourfold weft (7). In the next round, another double weft converges to pass under the same crossing dextral (8). In the last round, the fourfold weft and the double weft are overlapped into a sixfold weft (9). The opening is now reduced to about 2 inches in diameter.

The two-inch circular opening is closed by two three-ply braids, one for the dextrals and the other for the sinistrals. The dextrals, being uppermost, are collected into a bunch and held up with the left hand while the sinistrals are picked up from below and arranged on either side of the held dextral bunch. Turning the basket with the dextrals toward her, the woman proceeds with the braiding. (See *b.*)

In *b*, the dextral wefts are divided into three lots. One lot, composed of the far wefts, forms the first ply (1), and a second from the left forms the second ply (2), which crosses the first. The remaining wefts on the right form the third ply (3), which crosses the second. The three plies are braided to the end of the wefts and knotted. The basket is turned with the sinistral wefts toward the plaiter. The sinistral wefts are divided into three lots, the first coming from the back to form the first ply (1'). The second ply (2') comes from the back and includes wefts on the right, while the third ply (3') includes the remaining wefts on the left. The three plies cross as shown and continue the braid to the ends. The free braided tails then pass under a few crossing wefts (4) and farther on, under a single (5). The braids are carried over the bottom circumference and down the sides, where they are kept in position by passing under single crossing wefts.

In drawing the wefts together to form the plies, the two-inch opening is effectively closed and the braid technique fixes the closure.

The completed basket in Bishop Museum (C.10016; fig. 65, *a*) is 15.5 inches in diameter at the rim and 7 inches deep, and the closed leaflet wefts in the middle of the plaiting are 0.8 inch wide. The baskets seen in Kapingamarangi were gradually curved on the bottom circumference, but Eilers (2, p. 103) illustrates a round basket with a markedly convex lower surface.

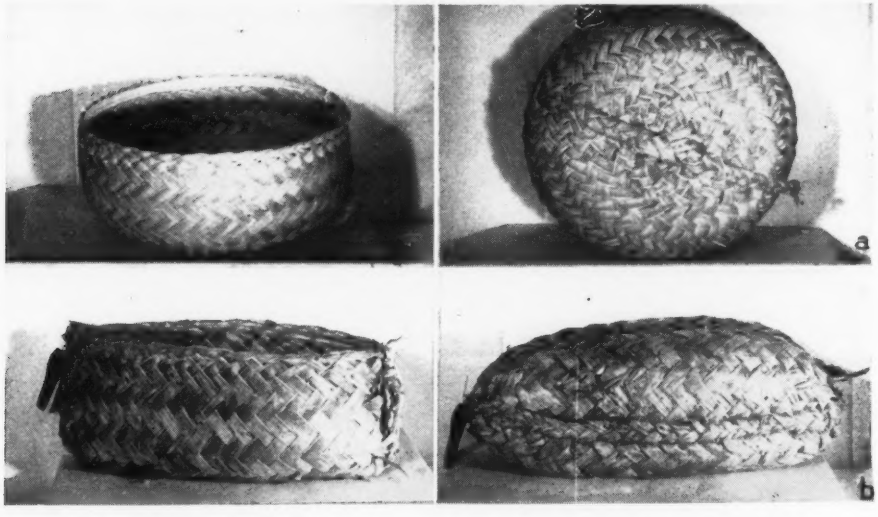

FIGURE 65.—*a*, Kapingamarangi basket; *b*, Nukuoro satchel.

The *kata* basket is a superior receptacle for holding clothing, weaving material, and various other articles, except food. The twined technique of the outer midrib strip is common throughout Polynesia, the common purpose being to add finish to the better class of coconut-leaf basket. I have described round baskets for Samoa (4, p. 202) and Manihiki-Rakahanga (5, p. 119). The Samoan basket differs in that it has an extra process in turning the bottom circumference and that the bottom is closed by dividing the weft ends into four

lots and making four braid tails instead of two. The Manihiki-Rakahanga basket closely resembles the Kapingamarangi technique in the simple turn at the bottom and the closure with two braided tails.

Satchel Basket

It is curious that the satchel type of basket with straight ends and a straight bottom is not made in Kapingamarangi, where there is a knowledge of all the processes involved in the making of it. A satchel with closed leaflets is common throughout central and western Polynesia, though absent from Hawaii, where the coconut leaf was used for no articles other than a form of fan, and from Easter Island and New Zealand where the coconut did not grow. Its absence in Kapingamarangi is rendered more curious by the fact that the preliminary stages of the satchel and the round basket are exactly the same in the use of two midrib strips from opposite sides of the leaf, the twining of the leaflets of the outer strip, the joining of the two ends, and the twilled plaiting of the sides. It is the treatment of the bottom that converts the article into either a satchel or a round basket. In the satchel, the bottom edge of the plaiting is brought together in a straight line, the dextral wefts braided in one course and the sinistral wefts braided in another, on the same principle as the *poroporo hari kau* (fig. 52). The pliable rim takes its form from the technique of the bottom. From a comparative study, it would appear that the satchel is a simpler form and that the round basket developed from it.

I was surprised, however, on calling at Nukuoro to pick up a basket of the satchel type which was made there (fig. 65, *b*). The basket (C.10107) is made of two midrib strips, 46 inches long, from each side of the leaf. The outer strip carries the sinistral wefts which are twined as in the Kapingamarangi round basket, and the inner strip carries the dextrals which are not twined. The first two rows of plaiting are in check, the rest in twilled-twos. Both sinistral and dextral extra single wefts are interpolated here and there. The ends are joined as in figure 63. The bottom is formed by bringing the sides of the plaiting together in a straight line, plaiting the dextrals in one course as a three-ply braid, and the sinistrals in a second three-ply braid. The braids are continued at each end into free tails which are carried up on the outer side toward the rim. After passing under one or two single crossing wefts, the ends are looped around the rim and tied to the standing parts with overhand knots. The completed basket is 20 inches long, 7.75 inches deep, and the closed leaflet wefts are just under an inch in width.

The technique of the Nukuoro satchel is identical with that of similar baskets in Polynesia. The distribution is so wide that it is probable that the type was known originally to the Kapingamarangi people and that they abandoned

it in favor of the round basket so long ago that they have forgotten. They accepted many things from Nukuoro, but evidently the round basket had become so popular that they did not accept what they considered to be an inferior type.

Panunu Container

The *panunu,* recently borrowed from Nukuoro, is made of green coconut leaf with open leaflets. It is a round, deep receptacle, useful for holding packages of cooked food. Being regarded as foreign, its technique is not recorded here.

PANDANUS-LEAF ARTICLES

The objects made from pandanus leaf were enumerated to me as roof sheets (*kaurama rouhara*), mats (*kahara*), sails (*ra*), baskets (*kata*), fishermen's hats (*kopai*) and a "square" ball (*parc,* formerly called *tipitipi*). The roof sheets have been described under houses, the baskets in rectangular shape are modern and made for trade, mats are made in fair quantity for local use, trade, and presents, the pandanus sail has been abandoned, the fisherman's hat is still in use, but the pandanus ball was not seen in any native game.

Mats

Pandanus mats were described as being of five kinds. However, these are actually varieties named according to size and function. The preparation of the leaves and the fundamental technique of plaiting is similar for all of the five varieties described below.

Kahara moenga (sleeping) mats are the most generally made at the present time. They average about 75 inches long and 34 inches wide. The wefts are double and run about five to the inch. They are used in pairs on cold nights, one beneath as a mattress over the coral gravel of the floor and the other above as a cover, which is termed *kahu.* The term *kahu* may be used as a verb as in the phrase, *ka kahu ti kahara* (the mat covers, or, the mat is used to cover). As a noun, it is phrased as *nia kahara kahu no ti moe* (the mat covers for sleeping).

The *ɯaɯa* is a more elaborate sleeping mat, made extra long so that one end can be rolled as a pillow (*ka ɯini, ka urunga ai*; rolled and used as a head rest). They are 5 to 6 spans (*roho*) long. One, owned by King David, is 36.5 feet long and 2 feet 6.25 inches wide. The plaiting is fairly fine, with nine wefts to the inch.

Kahara pata horo, also termed *kahara te,* are coarse mats used for carpeting the floor when necessary. The size is given as two spans long and one span wide, but those examined range between 11 and 12 feet in length and the width between 40 and 46 inches. The wefts are barely two to the inch, hence the term

pata horo (widely spaced). The leaves used are those which have dried (*popo*) on the tree and are dark (*ruri*) in color. Sometimes these dark-colored leaves are used with the lighter ones to form patterns in alternate colors, and such mats are further specified as *kahara unihaki.*

Kahara turi (*turi,* small) are of smaller size and are used as skirts by women working in the *puraka* and taro cultivations. A specimen made for the Museum is 46 inches long, 24 inches deep, and has seven wefts to the inch. The technique is exactly the same as the others, double wefts being used. When tied around the waist with a length of cord, the garment is termed a *teru,* generally pronounced now as *seru.*

Kahara tangata, according to some informants, were fine mats worn by men in olden days, hence termed *kahara tangata.* There is a possibility that they were a form of plaited *maro* or narrow loin cloth such as was used in the Polynesian atolls. The mat that Ti Rongorongo wore at the canoe building operations was an ordinary mat worn as a kilt by being tied around the waist with coir cord.

In order to help the people with their handcrafts for sale purposes, we advised them to make table mats, which are in demand in Honolulu and other places. These are made with exactly the same technique as the large mats but in sizes of about 16 by 12 inches and with five or more wefts to the inch.

MATERIAL AND ITS PREPARATION

Green leaves are cut from the pandanus tree, the central leaves of the head being left for further growth. In some of the tall trees trimmed for house building material, the lower branches are cut off, and the best leaves selected for plaiting material.

The ends of the leaves are usually trimmed and the leaves passed over a slow fire (*ka rara ti rou hara hongo ti ahi*) made of dry coconut husk sections. They are then laid on the ground for exposure to the sun (*toho ki ti ra*). There is no special method, such as the Samoan procedure of twisting each leaf into a spiral coil or the Cook Islands method of braiding the tip ends together. They are just laid out in rows on some clear gravel space near the dwelling houses. They are usually gathered up in the evening and re-exposed for two or three days. Toward the end of the drying period they are wound (*hapini*) around the hand, then exposed to the sun until quite dry. The dry leaves are wound into rolls, *ku mango, ta mai hakanika* (*hakanika* means winding into a large roll). Leaves are added in the winding process until the roll is considered large enough, then tied and stored until needed.

When the women folk decide to plait, the rolls are brought out and a number of women, members of the family, assist in the various processes of prepar-

ing the wefts. These preparatory activities usually take place outside the door of the house while one of their number sits inside doing the plaiting. Each woman sticks to one job, described by the verb denoting her work. They form an assembly line of four, dealing with the leaf in various stages until it reaches the plaiter. A group of women so engaged described their duties in the following sequence.

Ihi: The woman with the roll of pandanus leaves peels off a leaf. Starting at the butt end of the leaf, she pares off the side edges with the prickly thorns (*tara hara*) by splitting the end with the thumb nail and running it down to the tip. This splitting-off process is termed *ihi*. She then separates the midrib by using a piece of a butt end and running it down the grain on each side of the midrib. This process is termed *hahi*, or *tutave*. The midrib is discarded and the leaf is thus divided longitudinally into halves.

Hara: Another woman takes over the half leaves and scrapes them smooth with a piece of mature coconut shell (*tara ipu*), then passes them along to the next in the line.

Tuki: The operator is armed with a wooden mallet. She folds the scraped leaf to a length of about 10 inches. Using a smooth block of basalt (*hatu kara*) as an anvil, she pounds (*tuki*) the folded leaf upon it. After several blows, she rolls the folded leaf to alter the part directly on the stone and pounds again. She then winds the leaf around her hand and pulls out the inner end to hold to. Then she beats the leaf again, thoroughly softening the leaf (*tukituki ki maru*). The mallet used is cylindrical with one end cut straight down to the lesser circumference of the handle. It is given the descriptive name of *tukituki rou hara*, and the wood of which it is made was imported from Ponape. The stone anvil, like other similar stones on the island, is said to have been obtained from between the roots of trees which had floated to the atoll. When I asked Alfred Patterson what they used instead of stone, he stated that in former times the leaf was not pounded but was simply scraped and then split into wefts. This is interesting, for pounding is not used in Polynesia though it prevails in Micronesia, whence it probably diffused to Kapingamarangi in a not very remote period.

Toe: The scraped and pounded leaves are divided into even strips to form wefts by means of a sharp instrument made from the stinger of a sting ray by sharpening one side to form an even edge. The instrument is termed *tuku tawe* and the act of splitting into narrow strips is termed *toe*. In splitting the strips, the operator starts a bit away from the end of the butt so that all the strips in the half leaf remain united at the butt end. The unsplit butt portion is termed the *tepetepe* or *matahenua*. The prepared leaves are handed on to the plaiter. The person splitting the wefts gages their width according to the type of mat to be made, and she is wonderfully exact in maintaining an even width in leaf

after leaf. If the last strip at the edge of the leaf is too narrow, it is split off and discarded. Good plaiting requires wefts of the same width throughout. In the fine mat demonstrated for me the wefts were 4 feet 8 inches long, and there were nine to the inch.

Ranga: The process of plaiting is termed *ranga*, which, as *ranga* or *raranga*, prevails throughout the Polynesian area, including New Zealand. The plaiter sits inside the house. She cuts off the butt portion of one leaf to provide single wefts for making the left corner section of the mat, and those with the butt portion are used to continue the plaiting beyond the corner section.

A plaiting board (*papa ranga kahara*, board for plaiting pandanus mats) is used to provide a smooth hard surface to give support to the part being plaited. The one in use at the demonstration was 60 inches long and 11.75 inches wide, and it was convex on the upper surface. These boards are invariably made from the side of an old canoe hull.

PLAITING TECHNIQUE

Plaiting starts with single wefts to form the left hand corner, and the details, shown in figure 66, *a-d*, are as follows:

A dextral weft (*a*, 1) is laid down and a sinistral (1′) crossed over it. The dextral (*b*, 1) is doubled back over the sinistral (1′) to run parallel with its first course. A second sinistral (*c*, 2′) is added. It passes under the first part of the dextral (1) and over the second part to form the check pattern. The left end of the first sinistral (1′) is turned at right angles with an overhand turn over the second sinistral (2′). This turn forms the commencement of the left edge. The right end of the first sinistral (1′) is turned at a right angle with an underhand turn and passes under the second sinistral (2′). This turn commences the lower edge. The first sinistral (1′) has now been converted into a dextral.

In *d*, a third sinistral (3′) is added by lifting the three dextrals which have to pass over the sinistral to maintain the check pattern and this forms a working shed of three up and three down. The sinistral (3′) is laid in the shed and the raised dextrals dropped. The left end of the second sinistral (2′) is turned to continue the left edge and function as a dextral. The right end of the second sinistral is treated in the same way as in *c* to continue the bottom edge and act as a dextral.

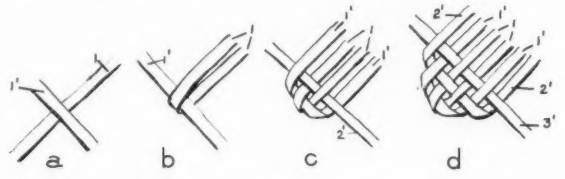

FIGURE 66.—*a-d*, pandanus mat, commencement.

The Kapingamarangi corner, which is termed the *matatuke*, differs from that made in central Polynesia which is formed by making a half turn at right angles and then another half turn which brings the second part of the dextral parallel with the first. The central Polynesian method makes a pointed corner,

whereas the Kapingamarangi corner is oblique for the width of one weft. In Hawaii, however, the corner technique is similar to that of Kapingamarangi.

Plaiting proceeds by adding single sinistrals and turning the ends of the preceding sinistrals to continue the left and bottom edges and function as dextrals. The working edge consists of dextrals, and the shed is formed by lifting the alternate dextrals needed to comply with the check pattern. After the sinistral is laid in the shed, the raised dextrals are dropped over it and the recumbent dextrals picked up to form the next shed. When the working edge reaches seven up and seven down, the addition of single sinistrals ceases, and the multiple wefts united by the unsplit butt portion come into use.

The dextral working edge from now on consists of six wefts raised and five down. The sinistrals are added from below but instead of separate singles, they are taken in turn from a butt portion placed at the lower edge of the plaiting but inclined obliquely toward the right like the dextrals. The dextrals are added from another butt portion placed at the upper end of the working edge so that the fresh dextrals run a short course in the working shed in a sinistral direction before they are bent in at right angles at the lower edge of the plaiting to assume their true function as dextrals.

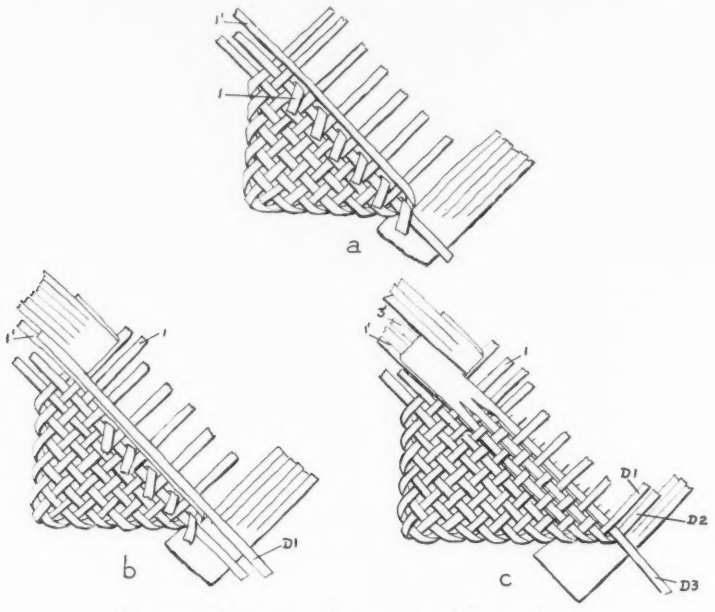

FIGURE 67.—*a-c*, pandanus mat, adding wefts.

Though the mats are mostly made with double wefts, the single technique is shown in figure 67, *a-c*, described below.

In *a*, the working shed is shown with six dextrals raised and five down, the wefts being cut short in the figure to save space. The lower butt portion supplies a sinistral (1′) which makes an overhand turn at right angles to turn left and enter the shed. The top raised dextral (1) is numbered.

In *b*, the top raised dextral (1) is first crossed over the sinistral (1′) in the shed. The upper butt portion is placed in position with its wefts running in a sinistral direction, but the unsplit portion is doubled back with the wefts to keep the working edge clear. The first weft (D1) on its left is bent over and split down so as to enter the shed where

it crosses the now recumbent top dextral (1) and lies in the shed above the sinistral (1′) already there.

In *c*, the plaiting goes on with the raised dextrals being drawn across the shed, and the recumbent dextrals raised to form the next shed. As the top dextral of the working set is dropped in each movement, the sinistral in the preceding shed is bent in at right angles with an underhand turn to continue the lower edge, pass under the new dextral in the shed, and be raised to form the sixth raised dextral for the new working shed. It also assumes its true position as a dextral. Note that the new dextral in forming the lower edge passes under the new dextral in the shed but not under the sinistral which is under it. The result is that the lower edge is at a lower level than the place where the new sinistral enters the shed. In the figure, three new sinistrals (1′-3′) and three new dextrals (D1-3) have been added from their respective butt portions. Thus in the last shed, the preceding new dextral (D2) is shown passing under the new dextral (D3) in the shed but not under the shed sinistral (3′). It will be raised with the other five recumbent dextrals to form the six raised dextrals of the next working shed.

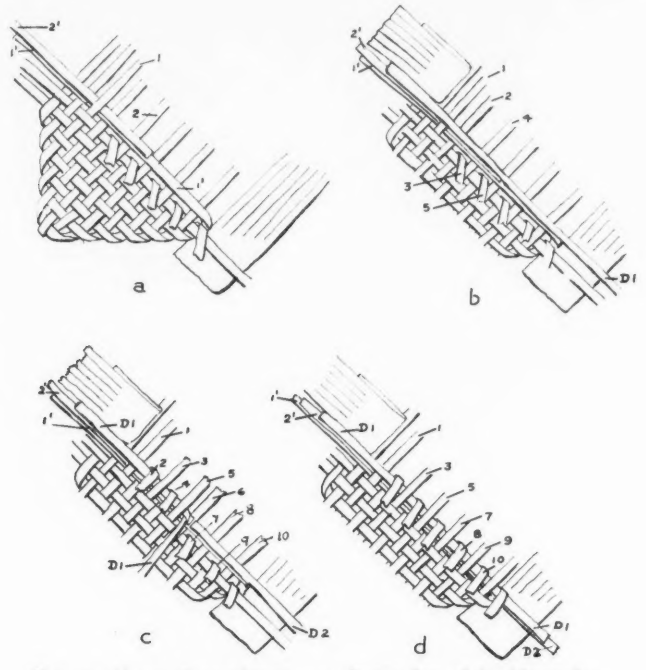

FIGURE 68.—*a-d*, pandanus mat, formation of double wefts.

A second sinistral and a second dextral are added to the working shed to form double wefts in the manner shown in figure 68, *a-d*, described below.

In *a*, is shown the working shed with the first sinistral (1′) added from the lower butt portion. A second sinistral (2′) is laid on top of the first, but its lower end is placed halfway down the shed. The top raised dextral (1) is drawn across the shed. In *b*, the upper butt portion is placed in position and the first dextral (D1) is placed in the shed above the double sinistral (1′, 2′). The next two raised dextrals (*c*, 3, 5) are drawn across the shed and the two upper down dextrals (2, 4) are raised for the next shed.

FIGURE 69.—Woman working on commencement, or lower section, of pandanus mat.

The first dextral (D1) is drawn to the side or temporarily raised to clear the working shed below the crossing dextral (5). The second dextral (D2) is now laid in the lower half of the shed, its upper end meeting the lower end of the second sinistral (2′). In *d*, the first dextral (D1) is restored to its position in the shed above (D2). The raised dextrals (7, 9) of the lower half of the shed are drawn across the shed, and the previous down dextrals (8, 10) are raised to prepare the next shed. The completed movement thus fixes the double sinistral (1′, 2′) and the double dextral (D1, D2).

The plaiting continues toward the right with the addition of butt portions until the length of the mat is attained (fig. 69). The right corner is formed in the same way as the left, but in reverse. The right edge is continued upward by turning in the dextrals with an underturn under the dextral above to continue the check pattern. The right edge is built up until it reaches the upper edge of the section being plaited.

The side edges are usually formed by turning the double wefts as singles or by interleaving, in which one weft of the lower pair which is being turned is passed between the wefts of the upper, which it has to cross to maintain the check technique shown in figure 70, *a-h*.

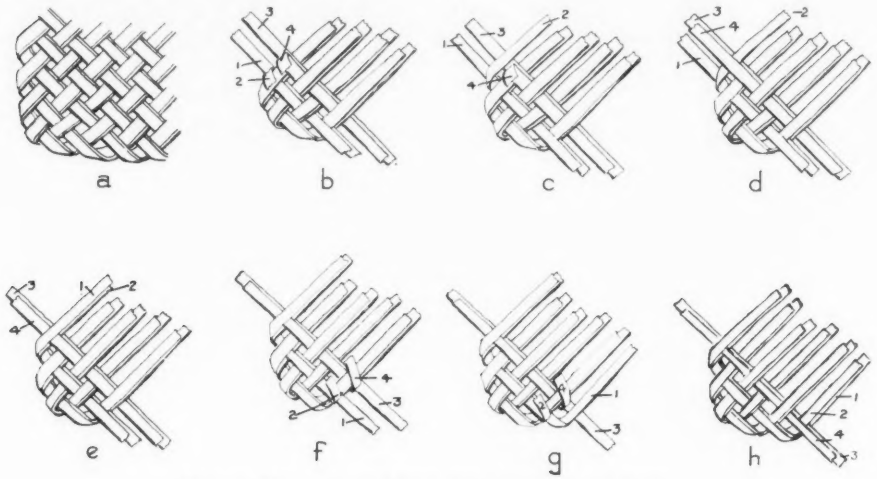

FIGURE 70.—*a-h*, pandanus mat, interleaving edges.

The single turns of the double wefts are shown in *a*. In *b*, the interleaving commences at the lower left corner. The lower double weft (1, 2) has to be turned over the upper double weft (3, 4) to commence the left edge, and the upper wefts in each (2, 4) are turned back. The upper weft (*c*, 2) makes an overturn across the lower weft (1), and above (3); the upper weft (*d*, 4) is straightened out over the crossing weft (2); the lower weft (*e*, 1) makes an overturn across the upper weft (4); and the interleaving is completed. For the lower border, both upper wefts (*f*, 2, 4) of the two pairs are turned back. The lower weft (*g*, 1) of the lower pair makes an underturn across the lower weft (3) of the upper pair. The upper weft (*h*, 4) of the upper pair is straightened out over the crossing weft (1) and the upper weft (2) of the lower pair is straightened out and then makes an underturn to cross under the upper pair and so complete the interleaving.

The technique of interleaving may be continued along both borders; but in practice, the single turn with double wefts had been used on all of the mats examined.

On completion of the commencement section, another section is started by building up the left edge until there is a working edge of 10 dextrals raised and 10 down. With narrow wefts, the working edge may consist of 12 up and 12 down. It is now straight plaiting without the further addition of butt portions, for it is a peculiarity of Kapingamarangi technique that the commencement edge is usually continued for the full length of the mat instead of forming a shorter end. Thus, the 4 foot 8 inch length of the wefts is sufficient for the narrower length of the width of the mat and there is no need for joining sections such as occurs in mats of central Polynesia. The working edge of the section is carried across the length of the mat and the right edge built up to the level of the section. Thus, by a number of sections, the width of the mat is completed.

As plaiting proceeds, the ends of the sinistrals above the shed lie on top of the dextrals. On the completion of a section, the sinistral ends form a layer above the dextral ends. In plaiting the next section, the plaiter gathers up a number of sinistral ends and doubles them back to clear the dextral layer, and she places her right leg over them to keep them down. Thus the working edge of dextrals is cleared and, as each shed is formed, the appropriate sinistral is straightened out and laid in the shed. When the group of doubled-back sinistrals has been incorporated in the plaiting, another group is doubled back and kept down by the weight of the right leg.

When the wefts near their ends, become too narrow, or are otherwise unsuitable, new wefts, singly or with butt portions, are added by overlaying on the old wefts, plaiting them as double wefts for a few strokes, and dropping the old wefts. The surface of the mat is dotted with weft ends and these, as well as butt portions, are cut off on the completion of the mat.

The next problem is the finish of the far edge of the mat. This is done in connection with the plaiting of the last section, because the free ends of the dextrals must be bent back and fixed in a working shed to form the finishing edge. The last section is built up from the left edge until it reaches the depth required, when the ends of both the dextral and sinistral wefts are disposed of (fig. 71, *a-e*), as described below.

a, shows the upper-left-corner working shed with four dextrals raised and four down, the top dextral (D) not being counted in the working edge. The four dextrals (1, 3, 5, 7) are raised on the right side of the sinistral (1′) which is to form the corner. With the shed formed, the next sinistral (2′) is laid in it, the top dextral (D) being raised and then dropped across it. On the right of the shed, the next sinistrals (3′, 4′) are shown as being turned back over the last crossing dextrals in the upper edge of the last completed plaiting section. As their turn comes, they are straightened out and fall readily into the working shed.

The corner sinistral (*b*, 1′) is doubled over the top dextral (D) and placed in the shed, the raised dextrals (1, 3, 5, 7) are crossed over it and the recumbent dextrals (2, 4, 6, 8) are raised to complete the plaiting movement and form the next shed. The next sinistral (*c*, 3′) is laid in the shed, the two top dextrals (D, 1) being raised to allow it to pass under and then dropped back over it. Note that the dextral below the top one is always crossed over the true sinistral in the shed before the top dextral is bent down into the shed to lie on the sinistral already there. The original top dextral (*d*, D) is turned at a right angle with an overturn to lie in the shed, the raised dextrals (2, 4, 6, 8) are crossed over it and the recumbent dextrals (3, 5, 7, 9) are raised. The dextral 1 is now the top dextral for turning into the shed; and as one dextral at the top is lost in the shed, a new dextral (9) comes into the working edge at the lower end of the shed.

In *e*, the top edge of the mat is completed throughout its length and the weft ends are then cut off. However, a short section of the far edge is shown with the ends cut off to illustrate the technique. The ends of the turned-down dextrals are cut off below the lowest crossing weft (D) in the shed and the sinistrals (S) are cut off above the highest crossing weft on the underside of the mat.

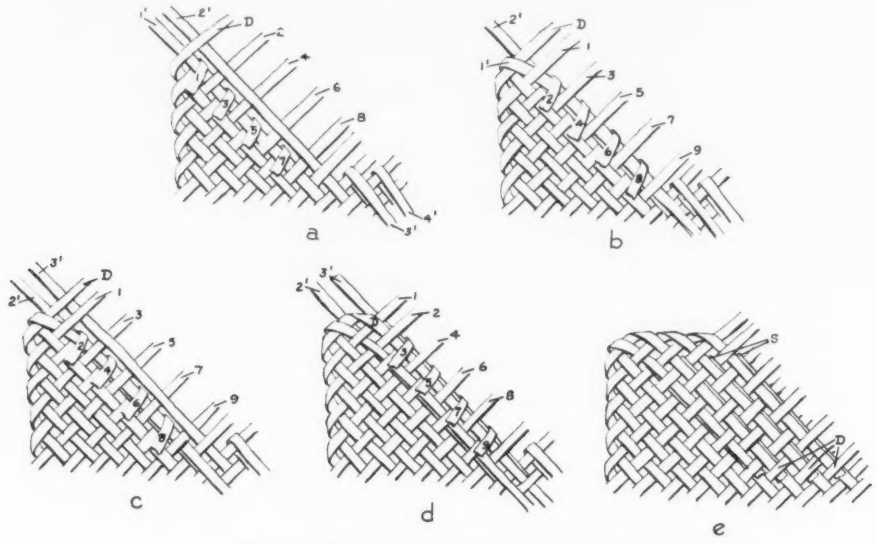

FIGURE 71.—*a*-*e*, pandanus mat, top edge.

From the figures, it will be observed that it is the turning of the top dextrals into the working shed which forms the edge finish. The sinistrals are dropped and cut off as described.

When the last section approaches the right end, the plaiting shed shortens as the upper and right edges converge to meet in the right upper corner of the mat. The problem of disposing of the weft ends and forming the corner is met by dropping the last three top dextrals, and placing the corresponding wefts from the right edge as singles in the shed, turning them to form the top edge and then fixing them by pushing them through under a number of crossing wefts in the plaiting. The method of pushing the weft ends under crossing

wefts is simple and ingenious. A short piece of coconut leaflet midrib is used as a needle. One end is split to enclose the weft end, the split being longer than the width of the crossing wefts. Holding the split end to grip the weft end firmly, the needle is pushed through under the crossing weft; and as the weft end appears on the far side, it is seized and the weft pulled through. The details of this right corner finish (fig. 72, *a-c*) are described as follows:

In the completed full working sheds to the left (*a*), the turned-down top dextrals are shown with the ends cut off after passing under five crossing wefts. With the shortening shed, the turned-in dextrals forming the right edge pass right through the shed as sinistrals to form an uncut fringe at the upper edge and the turned-down top dextrals pass under four, three, and two crossing wefts. In the figure, the wefts 1-4 belong to the upper edge and the wefts 1'-4' belong to the right edge. In the last completed shed, the last top dextral (4) to be turned down in the shed on the sinistral (4') is crossed by two wefts (2, 1') and its end is cut off. The next shed has two raised wefts (1, 2') and two down wefts (2, 1') and the dextral (3') on the right edge is turned into the shed as a sinistral.

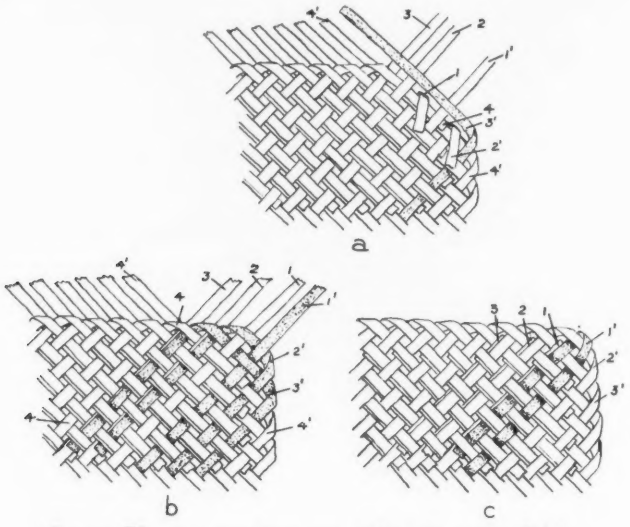

FIGURE 72.—*a-c*, pandanus mat, right top corner finish.

The sinistral (*b*, 3'), after reaching the top edge, is turned at a right angle with an underturn to pass under the weft 4 and the next four crossing wefts by using the midrib needle. The next dextral (2') on the right edge has been turned as a sinistral into the next shed, turned at the top edge and passed with the needle under five crossing wefts in a similar manner to the preceding weft (3'). The turns of the wefts 3' and 2' on the right continue the right edge, their turns at the top continue the top edge, and thus passing under five crossing wefts fix them firmly. The corresponding top dextrals 3 and 2 are left out. Two wefts (1, 1') remain to be dealt with.

The right-hand weft (*c*, 1') in the last figure is doubled over the weft 2' and passed down the course of the left weft (1) where it passes under five crossing wefts to fix it. The doubling over of weft 1' completes the right upper corner which resembles the other corners in appearance. The sinistrals projecting beyond the upper edge and the three dextrals (3-1) are cut off on the underside above the last crossing wefts as shown.

The last three wefts from the right edge play the principal part in the technique described, but the reverse technique may be adopted, that is, using the last three top dextrals to complete the upper and right edges.

Sails

The canoe sails (*ra*) which are now made of canvas were formerly made of pandanus leaf, plaited in long, narrow sections which were sewn together. Two matting sails were still in existence on the atoll during our visit, and we were so fortunate as to procure one of the complete strips of matting used in the manufacture of sails (fig. 73). This strip now in Bishop Museum (C.10083) is 34.5 feet long and 9.2 inches wide, and the plaiting has 7.5 wefts to the inch.

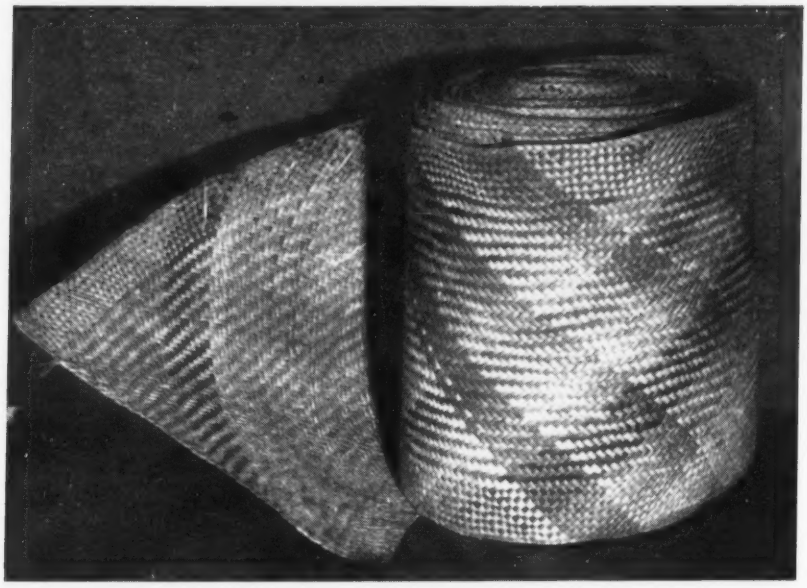

Figure 73.—Panel of sail matting.

The plaiting technique is identical with that of the pandanus mats already described. Commencing at the lower left corner, a working edge of 12 dextrals was established in check. The butt portions for the dextrals were added at the upper end of the working edge, and the butt portions for the sinistrals were added at the lower edge of the plaiting. The plaiting continued in check with the working edge of 12 dextrals, six down and six up, for a convenient distance, as it would have been too complicated to continue the section continuously for the length of 34.5 feet. Therefore, having reached a length of 5 or 6 feet,

some of the dextrals were doubled back under crossing wefts to prevent the right end of the section from unraveling. The first section in check is 1.1 inches in depth.

Returning to the left, another section was built up at the left edge but the unsplit butt portions at the upper edge of the plaiting must have been cut off to clear the way for the next section of plaiting. In this second section, the pattern was changed to a twilled-two, and this was continued to the end of the section. Some of the dextrals were again doubled back to lock the right end of the plaiting. A series of sections was added until the twilled part of the plaiting reached a depth of 7.0 inches. The last section was now built up from the turned left edge in check until the working edge was composed of 12 dextrals. The top left corner was formed with the same technique as that in figure 71, and the top edge formed in the same way. This last section in check is 1.1 inches deep, thus making the full depth of the plaited band 9.2 inches. The cutting off of the lower butt portions and of the individual dextrals and sinistrals at the upper part of the plaiting was the same as in the sleeping mats.

The technique described completed the left end of the plaited band for the five or six feet that was undertaken at one time. The rest of the 34.5 feet was continued with the same technique until the full length was attained. The right lower corner and the right edge were completed in the usual mat technique. In the right upper corner, however, the last two dextrals, instead of being pushed back under crossing wefts, were simply tied together with a reef knot.

The long bands were rolled up until used in making the sail. The full type specimen is 9.2 inches wide, as stated, but a piece of another specimen collected is 11.75 inches in width. It was made in the same way with the first and last sections in check and the part between in twilled-twos. The plaited bands used in the two sails seen were all made in the same way. The method of using the plaited bands in the construction of the sails is described in the section dealing with canoes.

Fisherman's Hat

A fisherman's hat (*kopai waka rama*), made of pandanus leaf, takes its name from *kopai* (cover, hat), *waka* (canoe), and *rama* (torch), as it was used at night on canoes while torching for fish, usually flying fish. The torch, made of dry coconut leaves, gave off a goodly number of sparks, and the fisherman, who held the torch in one hand and used the scoop net with the other, wore the hat to protect his head. Quite a number of these hats were in circulation during our visit, and fishermen often used them in the daytime while fishing with line or net or while canoeing.

These hats are conical in shape with short, serrated edges fore and aft. The material is scraped pandanus leaf such as that used for mats, and the hats are plaited by men. Tomoki, who demonstrated the plaiting, arrived at our quarters with a supply of pandanus strips each about 65 inches long and 0.5 inch wide. He also had an elongated hoop 12.5 inches long and 7.5 inches wide, made of a thin branch of hau tied at the ends to form an ellipse. He utilized a local plaiting board, which he placed lengthwise before him, and commenced operations by doubling some pandanus strips in the middle.

The commencement technique to form the apex of the hat is shown in figure 74 and described below.

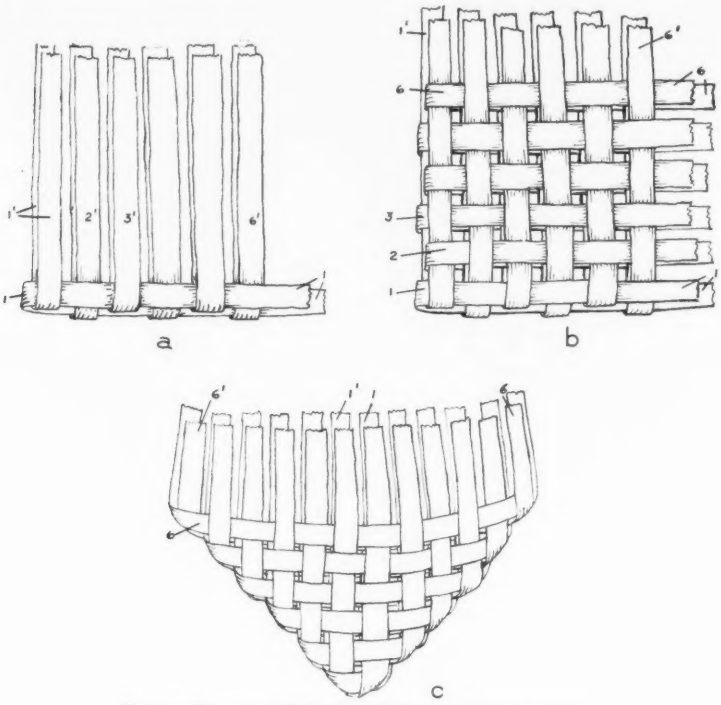

FIGURE 74.—*a-c*, fisherman's hat, commencement.

In *a*, a doubled strip with the closed end to the left is laid transversely on the board to form the first horizontal (1). A second strip (1') is hooked around the near limb of the first horizontal close to its doubled end on the left and drawn vertically upward until its closed end catches against the lower edge of the near limb of the first horizontal. This forms the first vertical (1'). A second vertical (2') is added in a similar way to the far limb of the first horizontal. Four more verticals (3'-6') are added alternately to the near and far limbs of the first horizontal.

In *b*, five horizontals (2-6) are added to the first vertical (1') to balance the plaiting. Check plaiting is observed, and as the closed end of the first horizontal (1) enclosed the far limb of the first vertical, the closed end of the second horizontal (2) is added to enclose the near limb of the first vertical (1'). The near limb of the second horizontal

(2) is carried across to form a check plait with the near limbs of the other verticals (2′-6′), and its far limb is carried across to continue the check plait with the far limbs of the five verticals. The remaining four horizontals (3-6) are added alternately to the far and near limbs of the first vertical, and they continue the check plaiting in their respective layers.

The plaiting stage reached in *b* is now tilted so that the closed corner on the left is brought to the middle and the left closed edge is turned to the right to bring it into the middle vertical line. The plaiting with its two layers is now edge on from the front back. The near and far edges are squeezed to bring them closer together and to flatten out the plaiting on each side of the middle edges. This results in the appearance shown in *c*.

Observe that in *c*, the horizontals in *b* have become verticals (1-6) on the right of the middle line and that the original verticals remain as verticals (1′-6′) on the left of the middle line.

What has been produced is a hollow cone formed by the check plaiting of the near and far limbs of the doubled wefts. It is impossible to give the exact appearance of a circular object in a flat drawing, just as a map on Mercator's projection does not represent the globularity of the Southern Hemisphere. In figure 74, *c*, the wefts which are fairly horizontal in the middle part of the plaiting, curve upward toward the sides and their free ends form verticals for the continuation of the expanding plaiting. The horizontal weft 6 really forms a curve with the concavity upward, and the free ends of the curve become sloping verticals at each end of the plaiting. During the process, the plaiter constantly pulls on the weft ends to keep the plaiting close. In figure 74, the wefts are purposely spaced to show up the far wefts more clearly.

After the cone commencement has been formed for the apex of the hat, the use of doubled wefts is no longer necessary. Working from figure 74, *c*, the alternate verticals crossed by the last horizontal are bent down, as in the general plaiting technique; a new horizontal is placed in position over the alternate verticals which have been left down; and the bent-down verticals are straightened back into position over the new horizontal to continue the check technique. The new horizontal automatically adds another vertical at each end. The plaiting is turned around to bring the far surface to the front, and a new horizontal is added in the same manner. It also adds another laterally as well as vertically, and the cone continues to increase in diameter as well as in depth. The technique of adding wefts alternately to the two surfaces continues until the cone reaches the depth required for the hat, which in the type specimen in Bishop Museum (C.10143) is 10 inches. At the depth of 10 inches, the circumference of the cone has also reached the required size for the rim of the hat.

The next process is to attach the hoop which forms the stiff rim of the hat, cover it, and add a second layer of plaiting over the first. The plaited cone is, therefore, reversed, with the pointed end upward. The elliptical hoop is slipped over the point and forced down over the plaiting until it is level with

the lower edge of the lowest horizontal weft on the near and far surfaces. The stiff hoop, being on the outer side of the plaiting, forces the circular rim of the cone into an elliptical shape with two wide surfaces and two narrower, rounded ends. The method of fixing the hoop is shown in figure 75, *a-i*, which represents the left end of one of the wider surfaces. The details follow.

In *a*, the hoop (1) is shown in position just below the lowest horizontal (2) and lying on all the weft ends. The vertical wefts which pass behind the lowest horizontal (2) are distinguished by the number 3. The vertical wefts (*b*, 3) from behind the lowest horizontal are doubled upward around the hoop (1) and may be fixed temporarily by passing their doubled ends under the crossing wefts above. These verticals have now changed direction upward and are pulled individually to draw the hoop close to the lowest horizontal (2). This technique extends along the whole surface edge until it reaches the point where the hoop crosses the right end of the lowest horizontal (2) in the same manner as shown on the left in *b*.

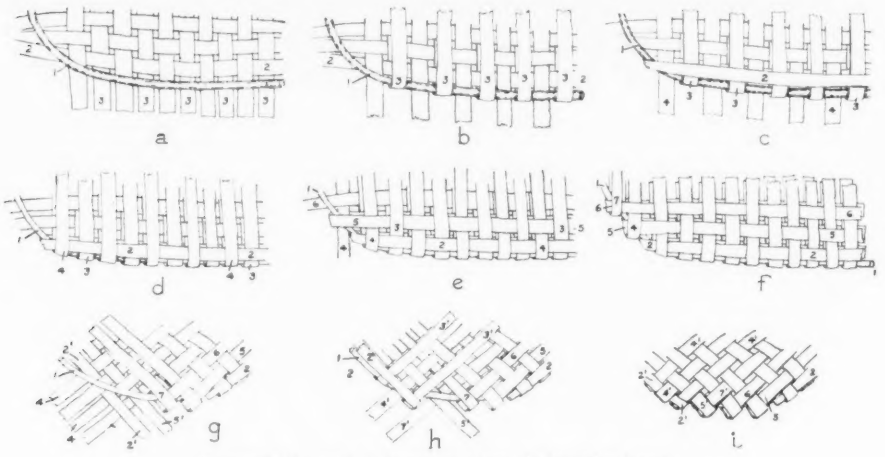

FIGURE 75.—*a-i*, fisherman's hat, fixing rim hoop.

In *c*, the lowest horizontal (2) is doubled back over the hoop (1) and stretched along its previous course thus covering the vertical wefts (3) which have been doubled upward. [A similar procedure is adopted with the right end of the horizontal (2) and the strips from the left and right may overlap and excessive length is cut off.] The remaining verticals (4) in *d* are doubled up over the hoop (1) and the lowest horizontal (2), thus completing the check plaiting at the rim and covering the hoop.

In *e*, the set of verticals (4) is left down and the alternate set (3) is raised. The next horizontal (5) is then doubled back over the hoop (1) and directed toward the right on its previous course. The raised verticals (3) are dropped to complete the check technique. The left end weft (4) has been left down to show the doubled-back end of the horizontal 5. (A similar process is applied to the right end, as with the first horizontal in *c*.)

In *f*, the third horizontal (6) is treated in the same way as the first and second, by being doubled back on its own course and crossed by the alternate set required by the check plait, which includes the new vertical (7). In doubling back the horizontals (2, 5, 6) on the outer side of the hoop, pointed projections forming a short serrated edge, are produced.

The hat is now turned to commence a similar technique on the opposite wide surface. In *g-i*, one end of the plaiting is shown with the hoop covered on the right side, as in *f*, and exposed on the left.

In *g*, the lowest three horizontals (2, 5, 6), which have been doubled back on the right, are shown and the corresponding two lowest horizontals (2′, 5′) on the left with the third (7) already turned back. The hoop (1) on the left remains to be covered.

In *h*, the appropriate verticals (3′), which from the front view are slanting, are turned back over the hoop and then the lowest horizontal (2′) is doubled back along its own course. (This is similar to the position in *c*.)

In *i*, the two verticals (7′, 4′) are doubled back as well as the set of alternates (not shown) along the lower border to the left, and the second lowest horizontal (5′) is doubled back along its own course. The plaiting technique in check is continued with the turned-back wefts. The doubling back of the weft 7′ over the second horizontal (5′), and the doubling back of the horizontal 5′ along its course forms a serration beyond the hoop like the other two on the right.

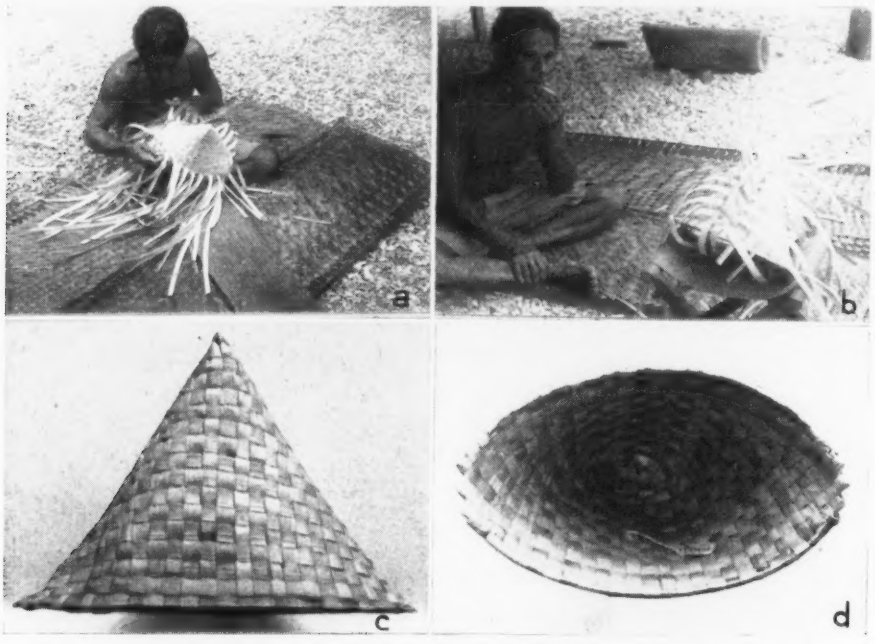

FIGURE 76.—Fisherman's hat: *a*, Tomoki commencing second outer layer; *b*, convergence of weft ends; *c*, completed hat, side; *d*, interior view, serrated ends.

The serrations formed at each narrow end of the rim are arbitrarily due to the necessity for doubling back the three lowest horizontals on each side. While they produce a form of ornamentation, they are not primarily made for that purpose. The rim hoop having been covered and all the long weft ends turned upward, plaiting in check proceeds upward toward the apex of the hat to provide a second, outer layer of plaiting. This stage of the plaiting is shown in figure 76, *a*, which includes Tomoki and his plaiting board.

The plaiting of the three lowest horizontals on each side with the crossing verticals establishes the beginning of the upward-moving second layer. Working from the bottom, the appropriate wefts to continue the check plaiting readily fall into position and simply retrace the course they followed in the first layer. There is this difference, however. In the first layer, single horizontals are added alternately on each side, their ends slanted downward around each plaiting end; and they descend on the opposite side as two verticals to meet the rim. Thus, we now have for each weft of the first layer two wefts working up vertically from the rim, crossing the ends in a slanting direction, continuing as horizontals on the opposite surface, and meeting in the middle line. The technique is to leave the two long ends free on each side of the middle line for the time being, leaving below the verticals that would combine with them in the check plait. This is done on the middle of each surface until the plaiting nears the top (fig. 76, *b*).

The long free wefts on one side of the middle line are cut off close to the edges of crossing wefts so that the cut ends will not show, and the free wefts from the other side are plaited across with the remaining verticals from below. When the gap is closed, the horizontals are pushed through under the crossing wefts and cut off.

In pushing wefts through under the crossing wefts, which are fixed, a piece of wood with a rounded flat point is used to prize up the fixed weft to allow the other to pass under it. The prizing instrument is particularly necessary in finishing off the plaiting at the apex of the hat. The completed hat is shown in figure 76, *c, d*.

The fisherman's conical hat made of plaited pandanus in check offers a problem in origin and diffusion. It is not present in any part of Polynesia. The conical hat made of wide strips of pandanus, sewn together, but with no plaiting, occurs in Guam and the Carolines. A Bishop Museum specimen from Sikaiana (C.6593), a Polynesian outlier in Melanesia, is composite in structure, the inner layer plaited in check like the Kapingamarangi hat, the outer composed of wide pandanus strips arranged and sewn together like the Guam and Caroline hats. The lower ends of the inner plaiting are doubled around the stiff rim hoop on its outer side and cut off. The wide, outer strips cover the ends and are doubled over the hoop from the outside, turned up on the inner side for about half an inch, and sewn with a running stitch above the hoop for the circumference of the rim. As there is thus no serious problem in turning the plaiting wefts around the rim to form a second layer, the characteristic fore-and-aft serrations of the Kapingamarangi hat are absent.

A Gilbert Islands hat collected by Katharine Luomala in 1949 forms a distinct variation from the Sikaiana hat. The inner layer is plaited in check and the outer layer consists of wide pandanus strips sewn together. However,

instead of a pointed apex, the top of the hat has a horizontal edge 3.5 inches wide, which avoids the technical problem of the peak and simplifies construction. Of the hats mentioned above, the Kapingamarangi type is by far the most complex in technique and displays the best craftsmanship. Conical hats probably spread into Micronesia from the west and diffused to some of the Polynesian outliers where changes in technique were developed. The subject requires further investigation through the collection of specimens throughout the individual groups of Micronesia.

CORDAGE

INTRODUCTION

All houses and canoes are lashed together with native cord, but foreign twine is used for fishing lines and some forms of nets. Cordage of native manufacture is in constant use, and its production is an everyday occupation of the men. The native fibers used are obtained from coconut husk (*puru*), the inner bark of the wild hibiscus (hau), breadfruit (*kuru*), and *warenga*, a member of the nettle family. Of these, cordage made from prepared coconut-husk fiber, or coir, is in general use, and it is doubtful that it could ever be satisfactorily replaced by trade cordage. Cordage of hau bast is used to a much less extent, and breadfruit bast cordage is rarely made now. Cords and threads of *warenga* are no longer made, but the people are able to demonstrate how the material should be prepared. For ordinary tying, strips of hibiscus bast are used; for binding food packages for cooking, pandanus and green coconut leaflets serve.

COIR CORDAGE

The term coir is used here to denote the fibers in the husk surrounding the coconut shell. It further infers that the fibers have been treated to cleanse them of interfibrous material and so make them suitable for use in making cordage. The native terms used in connection with the material and the products are as follows:

Coconut husk: *puru*
Husk sections: *akanga*
Treated husk sections (coir): *tukaha*
Single fibers: *moikaka*
To roll on thigh (v.): (*e*) *taka*
A rolled strand: *amu*
Two-ply cord: *tirahira*
Three-ply cord: *hari*
Three-ply rope: *hari*
To use three plies (v.): (*e*) *pini*
Three-ply braid: *pita kaha*

Treatment of Husk

The husk fiber selected for cordage is obtained from green drinking nuts (*rumata*). Fiber from mature nuts (*matu*) is not used as it is held to be too old, hence less strong than that of the green nuts. This is in contradiction to

the usage in Polynesia, where the mature husk is preferred. The husk sections (*akanga*), obtained by husking green nuts for drinking and culinary purposes, are collected in a coconut-leaf basket and soaked in the lagoon for a month or so. Usually a shallow place is scooped out at the bottom of knee-deep water, the husk segments laid in it, and some sand scooped over them. Large coral stones are laid on top to mark the spot and prevent the segments from drifting away. When the craftsman requires fiber, he wades out to his soaking material. At Touhou, there is a large pile of stones about 25 yards from the waterfront, and husk sections being soaked nearby are usually taken to the pile where the waste material can be thrown into the water. Each segment, in turn, has the short inner fibers (*purupuru*) torn off and the outer skin (*kiri taha*) peeled off before it is washed in the water. The bunches of fiber, which are about 10.5 inches long, can be beaten at the stone pile or taken ashore.

I watched a man at Werua beating husk which he had just brought in from soaking. Each segment was twisted before beating to wring out the water. He used a short wooden beater shaped like a food pounder and a basaltic stone as an anvil. The Werua craftsman proceeded to beat (*ta*) each segment in turn on his stone anvil. Holding the segment by one end with the left hand, he beat the far end so that the fibers spread out in a thin layer. He worked up toward his grip and then folded the bunch lengthwise for further beating. He rinsed the bunch and beat the end he had previously held. The particles of interfibrous material flew off under the beating and gathered in a heap beside the stone. After being beaten, the pale yellow fiber had a fine silky appearance. Each beaten segment adhered together as individual bunches of fiber and they were stacked up at the side. Before adding a fresh bunch to the pile, the craftsman ran his hand along it and removed any short pieces which stuck out. The process of beating is termed *ta ti tukaha*.

It was noticeable that there was no bad odor to the interfibrous particles which were beaten out, whereas in Samoa, where I watched the process, the waste material had a vile smell. This was probably due to a certain amount of change occurring in the mature husk used in Samoa.

The beaten bunches are dried in the sun and form the *tukaha* which provides the good fibers for cordage. The dried *tukaha* is put away in a basket to await the next process.

Rolling Strands

The preliminary step to making the cordage is the separating of the required amount of fiber from the *tukaha* bunch and rolling it into individual strands termed *amu*. As the general term for rolling on the bare thigh is *taka*, the process of rolling strands is termed *taka ti amu*. The craftsman sits cross-legged on the floor with the *tukaha* bunches beside him. Picking up a bunch

with his left hand, he proceeds with the forefinger and thumb of his right hand to detach the quantity of fibers necessary to form the strands for the cord he is about to make. This varies with the thickness of the cord required, as different sizes are used for different purposes. For instance, the cord used in fish traps and nets is much thinner than that used in lashing houses and canoes, whereas much thicker strands are required for ropes.

Having separated the fibers for a strand, the craftsman looks at it and removes any short pieces that are noticeable. If this makes the strand too thin, he adds more fibers from the bunch. He then proceeds to roll the fibers together on the bare right thigh with the palm of the right hand. The first preliminary roll is downward toward the kneecap, but more pressure is applied on a following upward roll, in which the left end of the strand is held in the left hand to insure the twisting of the fibers over each other. In the upward roll, the full width of the palm is utilized, first with the ulnar part over the right end of the strand, then a gradual transfer to the radial side of the palm over the left half of the strand. In this way, a tight, compact strand is formed. The completed strand is of even thickness, but the two ends thin off slightly, a matter of practical use when the strands are added to the plies of a cord. The craftsman continues to increase his pile of *amu* strands until he has enough for the next process.

Twisting Cord

The two-ply cord is in general use in Kapingamarangi and Micronesia, rather than the three-ply braid generally used in Polynesia. The general term for two-ply cord is *tirahira*, but the plural is *nia hirahira*. It is evident that the singular article *ti* has been fused in the general term *tirahira*. There is a strong distinction made both in technique and in the use of cord that is twisted on the right thigh and that which is twisted on the left. In referring to them, it is convenient to call them right-hand cord and left-hand cord.

In rolling the right-hand cord, the two prepared strands are held at one end with the left hand, and the downward and upward movements are made with the right palm on the bare right thigh. In the downward movement, commencing at the upper part of the thigh, the two strands, which now become plies, are kept apart and rolled separately. On the upward, return movement, the two plies are brought together and rolled over each other in a tight twist by the firm pressure of the outer or ulnar side of the palm. At the end of the movement, two to three inches of close twist are formed, with the ends to the right loosely twisted. Holding the right end of the firmly twisted part with the left hand, the craftsman unravels with his right hand the loosely twisted part on the right separating the plies, and another section is tightly twisted by the downward and upward rolling movements. When a ply approaches its end,

a fresh strand is added to it by overlapping the two thinner ends which, when combined, make up the average thickness of the ply. And so, by adding fresh strands as required, the rolling of the cord continues until the desired length is reached. The term *taka* is applied to the rolling process for cord, as it is for strands.

Left-hand cord is rolled in exactly the same way, except that the ends of the strands are held with the right hand and the rolling is done with the left palm on the left thigh.

DIFFERENCES BETWEEN RIGHT- AND LEFT-HAND CORD

In a right-hand cord, owing to the upward pressure of the right hand, the plies of the cord are twisted over each other obliquely from right to left; in left-hand cord, the reverse takes place in that the twists are from left to right. No matter which way the cord is held, the twists will always run in the same direction, and the differences between right and left cords can be distinguished at a glance. The use of the two cords has been arbitrarily decided, and it is wrong (*hua aitu*) to use a right-hand cord in canoe and house lashings and equally wrong to use a left-hand cord in making nets or fish traps.

According to native craftsmen, the right hand (*kautonu*) being stronger than the left (*kauihara*), the right-hand technique is employed to make firmer and tighter cords which stretch very little. The right-hand cord in general use is about 2 mm. thick and runs about 7.5 twists to the inch. The smaller right-hand cords are used in making fish nets, fish traps, and minor articles. They may be used to form the plies for the three-ply ropes termed *hari*. The number of twists may be counted by measuring off an inch with the calipers, placing the upper limb on the right of the cord just where a ply appears to twist over from the right edge to run obliquely down to the left. The left hand (*kauihara*) being weaker than the right, the left-hand technique is used to make coarser cord with looser twists which are also less in number per inch. The strands are thicker; an average piece of left-hand cord is about 3 mm. thick with 3.5 twists to the inch, or even fewer. These cords will readily stretch and are used for lashing the parts of houses and canoes. When a lashing turn is made, considerable pull is applied before the turn is held in position by pressure with the left thumb against the wood. The stretch, or elasticity, in the left-hand cord is said to make the lashings firmer than if the less elastic right-hand cord is used.

An interesting indication of the origin of the left-hand cord and its probable substitution for three-ply braid occurs in the terms applied to the two kinds of cord. The right-hand cord is termed *tirahira henua nei* (two-ply cord of this land) and the left-hand cord is termed, in contradistinction, *tirahira mai tai* (two-ply cord from the sea). Thus the descriptive terms imply that the right-hand cord was well-known and local, the left-hand cord introduced from

abroad. On asking informants as to what was used for lashing houses and canoes before the left-hand twist was introduced, they admitted that it was possible that three-ply braid (*pita kaha*) was much more common in olden times than now. It is possible that the Polynesian people of Kapingamarangi formerly used three-ply braid in house and canoe lashings and that the left-hand cord was later introduced, probably from Micronesia, and adopted because it was equally effective and more easily and quickly made.

In cordage, the terms used for small and large, or thick, are *tuwi* and *tuwe*, whereas the terms applied to other objects are *turi* (small) and *tamana* (large).

Three-ply Cord

Three-ply cord is not made with coir fiber by the *taka* process of rolling on the thigh but is made with hau, breadfruit, or *warenga* fiber. A three-ply twist, however, is made with two-ply cords used as plies. The process is termed *pini*, and the resultant three-ply cordage is termed *hari*. The specific term for the process is *pini hari*.

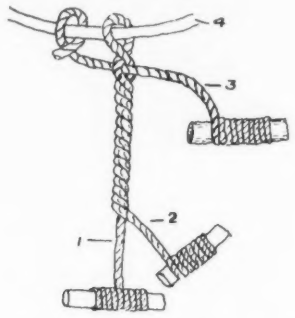

Figure 77.—Twisting three-ply cord.

The *pini hari* process was demonstrated by Alfred Patterson, who used a supply of two-ply, right-hand cord (*tirahira*) and three short sticks, to which he gave the descriptive term *rakau pini hari*. He tied a loop (fig. 77, 4) around the trunk of a nearby breadfruit tree and passed one end of a long cord through the loop to half of its length. He tied the first stick to the end of one limb (fig. 77, 1) and placed his foot on it to make the line taut. (The first stationary limb anchored with the foot was termed the *matuame*.) The other end of the doubled cord, he tied to the second stick (fig. 77, 2) and wound the cord on it until the stick reached the loop around the tree. He tied the end of another cord to the suspensory loop with a half-hitch to the left of the first loop after passing it between the two limbs of the doubled end. This third cord was left out for the time being (fig. 77, 3). The second cord, closely rolled on the second stick, now became active; Alfred twisted it around the stationary

matuame cord to form a two-ply twist. He said that if the second cord appeared loose (*maruru*) in its twists, it was twisted on itself by revolving its stick, and so stiffened (*hakamaro*). Thus the two-ply cord used was 2 mm. thick with eight twists to the inch. It remained 2 mm. thick, after being twisted on itself, though it had 12 twists to the inch. As the second cord was twisted around the stationary one, Alfred paid off its stick as it passed behind the stationary cord. In this way, the two-ply cord, consisting of two-plies of two-ply cord, was continued for some length, and its thickness was 3 mm. The second cord he tied to the first temporarily.

Next, the third cord was rolled closely on its stick and, commencing at the top, was wound closely around the two-ply composite cord in the same way as the second cord. However, here the third cord passed around in the groove between the first and second cords. The resultant three-ply composite cord was 4 mm. thick with 5.5 twists to the inch. So, by successive lengths of two-ply and then three-ply, the three-ply was continued to the required length. In the specimen made by Patterson, the plies were right-hand cords but the twists of the three-ply cord were made from the left, resulting in a thick, left-hand cord, or a thin rope.

Three-ply Rope

For ropes, also termed *hari*, the technique used is the same as that described for three-ply cord. However, everything is on a larger scale, with thicker left-hand cords used for the plies. In preparing for a rope, the strands of fiber (*amu*) are 3 mm. thick in the middle and the left-hand two-ply cord is 5 mm. thick with three twists to the inch. An even thicker cord for a longer rope has strands 4 mm. thick, the cord is 8 mm. thick, and has one twist to the inch.

When a demonstration of rope making was given by an old man named Rimari, using apparatus belonging to Huatou, moving pictures were taken by Mr. Lathrop. The rope, which was 10 mm. thick, had already been made for some length and was wound on a frame, consisting of two side poles, 7 feet 4 inches long. The outside distance between the two parallel poles was 23 inches, and the poles were 2 inches thick at the lower ends and 1.4 inches at the upper ends. Three cross bars were lashed to the side poles, the upper interval being 25 inches and the lower, 30 inches, the lowest bar being 20 inches from the lower ends of the side poles. The bars projected beyond the side poles, and the side poles projected above the upper cross bar thus furnishing a number of pegs around which the slack of the rope was wound. (See figure 78, *a*.)

From the frame, the rope extended to the operator, who sat on a mat close to the frame and worked backward. When he reached the far end of the mat, he wound up the slack on the frame, and started again from the front of the mat. The plies of two-ply cord were 5 mm. thick. The preliminary two-ply

twist of two cords had already been completed and was wound around a piece of flat board which was 43 inches long and had an average width of 4 inches. Any piece of board is used.

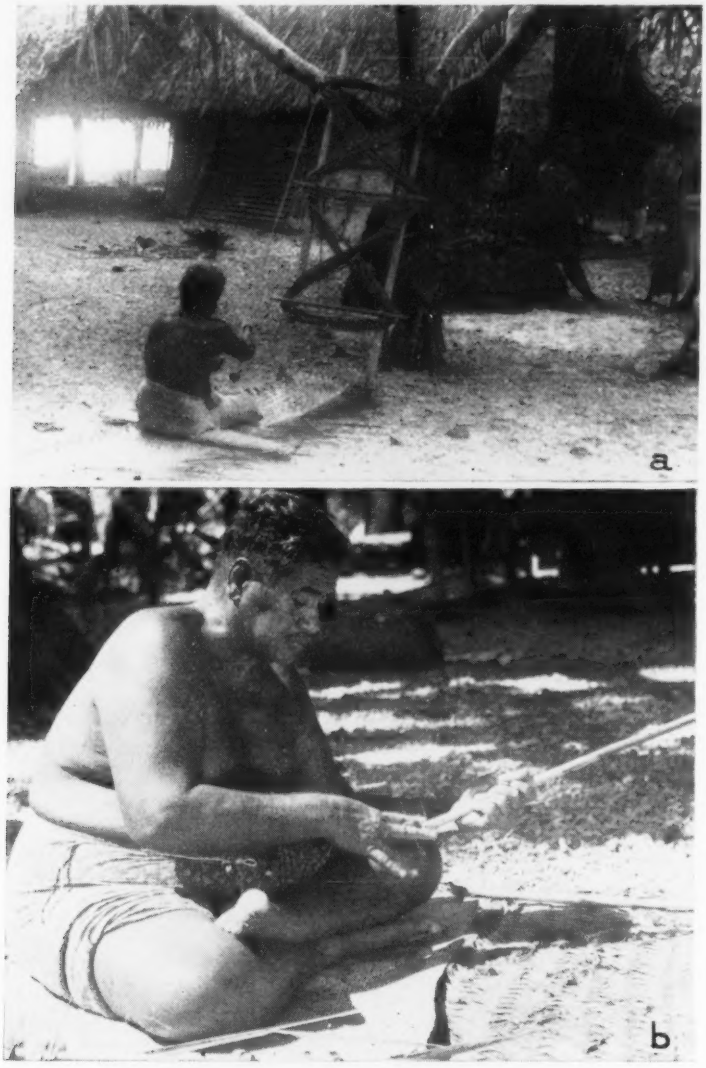

FIGURE 78.—*a*, rope frame; *b*, King David scraping *warenga*.

The third cord was closely wound around a stick with knobs at each end. It was 23 inches long, including the knobs, and the middle diameter was 1.1 inches. The part of the stick inside the knobs was covered with one layer of

turns, and a second layer was being unwound. With the main cord tautened by sitting on the board, the operator twisted the short stick tightly around the finished two-ply, the third cord running in the groove between the two completed plies. He released the third cord from the stick with each turn by giving the stick a reverse twist at the back of the main cord. After a sufficient demonstration, the slack was wound up close to the frame, the wound board and stick placed beside it, and the work left to be continued later. In the first stage of twisting the two-ply cord, the board was used with the stationary cord, and a knobbed stick with the second. When the full length of two-ply was continued, the completed two-ply was wound on the board and the third cord wound on the freed stick with knobs. The dimensions of the rope were as follow: the single ply on the short stick was 5 mm. thick with 5.5 twists to the inch; the two-ply on the board was 10 mm. with 1.5 twists to the inch; and the three-ply completed was 10 mm. with 3 twists to the inch.

HIBISCUS CORDAGE

In Kapingamarangi, as in Polynesia, the wild hibiscus (*Hibiscus tiliaceus*) is one of the most useful plants. It supplies suitable poles for the outrigger parts of canoes and bark for cordage, tying material, and warps and wefts for weaving. As in Polynesia, it is called hau. The terms associated with hau cordage are as follows: bark, *kiri hau*; bast, *konchanga*; cordage, *ti* (the) *roahi*.

As the term *roahi* is also applied to cordage made from the bast of breadfruit and *warenga*, hau cord is distinguished by the qualifying term for bast (*konchanga*), namely *hanga*, as *ti roahi hanga*. A two-ply or three-ply cord is distinguished by giving the number of plies with the prefix *tua* as *ti roahi tuarua* (two-ply) and *ti roahi tuatoru* (three-ply). The term *roahi* applies solely to twisted cords, for braid is not made with hibiscus bast.

To obtain the bast for cordage, the bark (*kiri hau*) is removed (*ihi*) from young trees or saplings in strips. The subsequent treatment is summed up in the words "ka hati, ka kumi, ka ihi" (bend, pinch, strip apart). The strip of bark is bent and creased (*hati*) with the outer skin to the outside, the bend is grasped firmly (*kumi*) with the fingers and thumb of the left hand, and one end of the doubled strip is given a sharp jerk or jerks (*kamu*) with the right hand. This breaks the fibers of the outer bark at the bend without breaking the bast fibers and separates the two layers sufficiently for the outer bark to be seized and peeled off (*ihi*) from the inner bast. Then the strip is reversed and the outer bark removed in the same way. When the bast strips have been soaked in the lagoon for a day and dried in the sun they have become the *konchanga* from which cordage is made. A more elaborate method of separating the bast from the bark is used in preparing material for weaving.

Two-ply cord (*ti roahi tuarua*) is made from the prepared bast (*konehanga*) by the *taka* process of rolling on the thigh. The bast strands are much longer than those of coir and do not require fresh strands so frequently. Nor are the strands rolled beforehand, the downward rolling in the actual *taka* process being sufficient. However, during the process a ply is given an individual roll if the fibers appear straggly.

Three-ply cord (*ti roahi tuatoru*) is also made by the rolling process on the thigh (*taka*). An old man named Tukohi made a three-ply cord for a fishhook, with which he demonstrated the attachment of the snood to the hook. He used the *taka* process on the right thigh in a similar manner to the rolling of coir cord, but with three plies instead of two. At times, he rolled individual plies before he rolled the three together. He gradually thickened the cord by adding extra strips of bast to the plies. The cord started off with a thickness of 3 mm. and was 5 mm. thick with 4.5 twists to the inch at the end of 20 inches. He carefully went over the completed cord and cut off any fragments that stuck out from the ends of the additional strands.

BREADFRUIT CORDAGE

Breadfruit bast is thick and formerly supplied the material for bark cloth as well as for making cordage in two- and three-ply twist. Breadfruit trees grow abundantly, and numbers of saplings are always found near the older trees in the outer islands. Thus a supply of bast is procurable from saplings without interfering with the older fruit-bearing trees. However, breadfruit cordage is seldom made now. The terms associated with it are: bark, *kiri kuru*; bast, *tapahati*; twisted cordage, *ti roahi*. It is wrong to say that a *roahi* cord is made from breadfruit bark (*kiri kuru*), because it is made from bast (*tapahati*) which is a different thing.

The bast required in small quantities for cordage is procured in much the same way as that of the hibiscus. Strips of bark are torn from a breadfruit sapling and the inner bast separated from the outer bark by creasing the strip and jerking the two layers apart at the crease. The inner bast is soaked in the lagoon for some hours or for a day, then dried in readiness for cordage material. The process of twisting on the thigh is similar to that used with hau bast. Breadfruit bast cord was used formerly in making some fishing nets, a specimen of which was seen in one of the canoe houses.

WARENGA CORDAGE

The fiber obtained from *warenga* bast is recognized as being much stronger than hau or breadfruit, but, owing to the labor of preparing enough from the scanty bast, it has gone completely out of use. Its abandonment has been accelerated by the easily acquired trade cordage. However, its memory is still

fresh and King David made a special trip to the outer island of Pumatahati to obtain *warenga* with which to demonstrate the technique of procuring the fiber. He returned with half a dozen *warenga* rods about 5 feet long and 1 inch thick at the butt ends. He explained that the bark was so thin that the methods of removing the outer bark of hibiscus and breadfruit could not be followed and that a special method had been devised for dealing with it.

David selected a thick single fiber of coconut husk (*moikaka*) which he tied into a loop with a reef knot. The loop was large enough to admit the forefinger and middle finger of the right hand up to the distal joint. With the loop stretched, there was a gap of about 0.75 inch between the fingers. Starting at the butt end of a rod, David proceeded to scrape off the outer bark by drawing the loop toward him in short strokes (fig. 78, *b*). The brown outer bark peeled off very easily, showing the green outer surface of the bast below. The rods were scraped from end to end in short sections and left out in the open to dry in the sun. This took place in the forenoon.

In the afternoon David dealt further with the rods. The wood was dry and soft and broke easily, and snapping one end of a rod with the fingers so as to leave one side still connected by bast, David peeled as much fiber as possible from the main rod by gently pulling the short piece downward with the fibers adhering to it. The fibers were in a very thin layer and ran off the main stick quickly. The fiber strip was then peeled off the short piece. Another short piece was snapped, care being taken to leave as much fiber attached to it as possible. This strip was then peeled down until the rod was stripped. Though the strips of fiber were rather thin, David went on patiently stripping rod after rod. He combined two or more thin strips to form strands, reversing their ends as he laid them down so as to have an even thickness. The pieces were then rolled on the thigh to form the twisted strands.

The strands were rolled on the right thigh to form a two-ply cord by the *taka* process. This cord, called *roahi* as are hibiscus and breadfruit cords, was formerly used for fishing lines and some forms of net.

Alfred Patterson said that the old name for the plant was *oronga* but that it was changed to *warenga* because of the sticky sap (*ware*) which clings to the fingers during scraping.

LASHINGS

CRAFTSMAN'S COIL

To avoid tangling and having to pull on a long single cord used in lashings, a craftsman forms a coil so wound that the working end can be pulled out without the coil collapsing. This coil is formed as follows: (1) Figure-of-eight turns are made around the little finger and the thumb across the palm. At the end, the coil is doubled over and the outer end of the cord tied with

a clove hitch around it. Or (2) turns are made around the middle finger, wrist, and thumb. This method is adopted when extra long pieces formed a larger coil for use in house lashings.

As the winding begins, the commencement end is left long to project out of the coil, as this is the part to free for starting the lashing. The orthodox technique is to fix the commencement end, after which the subsequent turns can be drawn taut with both hands if necessary. When the turn is taut, the left thumb holds the cord against the woodwork while the right hand pulls the coil to free the required length and make the turn. It will be understood that when a knot or a hitch has to be made, the turn is made in a large, loose loop that is large enough for the craftsman's coil to pass through. In lashing the thatch to the thatch rafters of the roof frame, the coil is not used, as it cannot be pulled through the holes made in the thatch sheets.

KNOTS AND LASHINGS

Knots do not occur in any variety, and more attention is paid to the process that produces the knot than to the knot itself. The following terms are in use: *ti pana*, an overhand knot; *e no*, to knot (v.); *e no tata*, a slip knot; *e no ko* or *e no mau*, a secure knot; and *e no pou*, a clove hitch.

The one definite knot with the definite article *ti* is the overhand knot (*ti pana*) used as a stopper at the end of a cord (fig. 79, *a*). The word *pana* may be used as a verb, as in *hakapanaina tirahira* (tie an overhand knot on the coir cord). In many of the lashings, it is usual to tie an overhand knot on the end of the cord used.

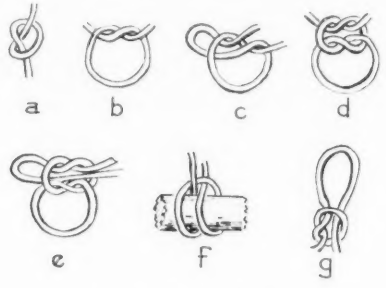

FIGURE 79.—Knots: *a-c*, overhand; *d-e*, reef; *f*, clove hitch; *g*, running noose.

The verb *no*, to knot, has a curious nasal sound approaching *ngo*. It has the verbal particle *e* used before it, never the definite article *ti*, which denotes a noun. Thus, in the term *e no tata* applied to a slip knot and *e no ko* or *e no mau* applied to secure knots the use of the particle *e* seems to imply that it is the action of tying that is referred to and not the actual knot. So an overhand knot (fig. 79, *b*) tied around something is referred to as securely

tied (*e no mau*), whereas an overhand knot tied with a loop which can be pulled free (fig. 79, *c*) is referred to as being tied to slip (*e no tata*). The same applies to a reef knot (fig. 79, *d*) and a reef knot tied with a loop (fig. 79, *e*). Apparently there is no specific name for a reef knot, though it is often used. A clove hitch (fig. 79, *f*), which is always used in fixing the halyard to the mast (*pou*), is described as *e no pou* (to knot the mast).

The craftsman's coil is used in all lashings, and this influences the technique of commencing and finishing the lashings. The craftsman places the free end of his coil against the wood, holds it down with the pressure of the left thumb and makes a loop around the parts large enough for the coil to pass through to make his knot. When the coil has been passed through the loop, it is dropped, for it will not unravel and it hangs close at hand for further turns of the lashing. The right hand is thus freed to draw the loop taut and complete the commencement fixation. Various forms of commencement fixation are used as follows:

The overlaid commencement is used in crossed lashings in which the end of the cord is overlaid by a crossing turn as in binding two cross pieces together, such as the lashing of the main rafters to the ridgepole (fig. 34, *a*) or the tie beam to the tie-beam plate. It may also be used in transverse turns around a single rod by bending the end of the cord at right angles and covering it with the subsequent transverse turns.

The running noose commencement is made by passing the cord around the rod and tying the end around the standing part with an overhand knot (fig. 79, *g*). The loop so formed is run down taut around the rod. This is used in commencing the tying of thatch sheets where the running noose is made around the narrow end of thatch rafters just above the eaves batten (fig. 42, *a*).

The single overhand knot commencement, in which a cross bar is tied to a vertical rod is shown in figure 80, *a-f*, and is described below.

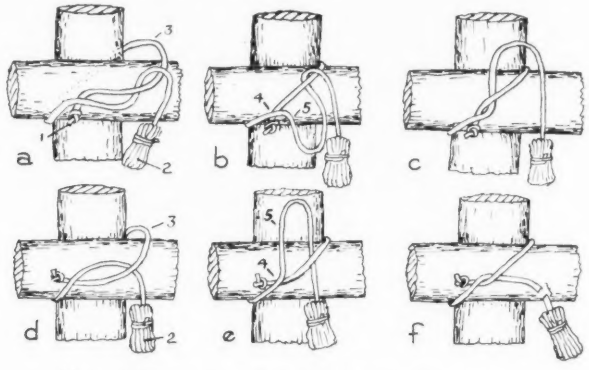

FIGURE 80.—*a-f*, overhand knot commencement.

The knotted end (*a*, 1) is held down on the bar with the left thumb and the coil (2) is carried around the oblique corners in a large loop (3) to cross over the knotted end from the left or above and then under the loop from below. In *b*, still keeping pressure

on the knot, the right hand draws the loop taut over the knotted end and the left thumb changes position to the crossing (4). The slack loop (5) is now below the taut turn. In *c*, the cord with the coil is pulled to remove the slack and the taut turn fixed with an overhand knot. In a variation (*d*) the cord crosses the knotted end from below and consequently passes back under the loop (3) from above. In *e*, the oblique turn is drawn taut as before and fixed by the left thumb at the crossing (4). The slack loop (5) is now above the oblique turn, and in *f*, the slack loop is pulled through and the tight overhand knot results.

The above description and figure 80 are given to illustrate the use of loops to allow the coil to pass through and form the knot to fix the commencement. In the following variations, the use of the coil and the initial loops are an essential part of the techniques involved.

The double overhand knot may be used as a complete lashing or as a commencement technique. It consists of the addition of a second loop, or turn, to the single knot. When made on a fishhook or the end of a rod, where the loop can be drawn over the end, only one loop is necessary (fig. 81, *a-d*); but where the end of the rod is too far away, two loops are necessary (fig. 81, *e-h*). The technique illustrated by figure 81 is as follows:

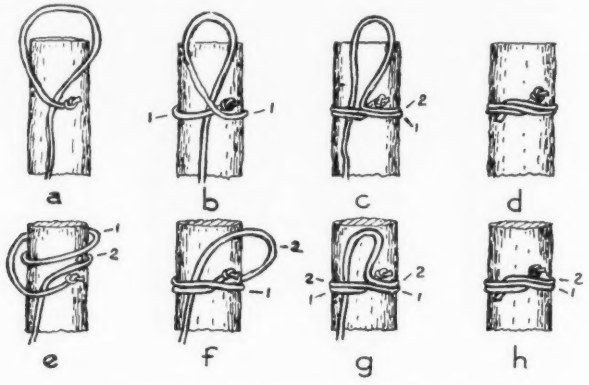

FIGURE 81.—*a-h*, double overhand knot.

In *a*, the knotted end is laid against the wood, and a long loop made with the cord passing under the knotted end. In *b*, the knot is held down with the left thumb and the loop is passed around the rod to make a transverse turn (1) and crossed upward over the knotted end. The loop in *c*, which is long enough to pass over the upper end of the rod, makes a second transverse turn (2) around the rod on the upper side of the first turn (1) and crosses over the knotted end. In *d*, the cord is now pulled downward to remove the slack, the cord severed, and the double overhand lashing results.

In *e-h*, the rod is too long to slip the loop over the end, but it is cut short in the line drawing to save space. The knotted end in *e* is held down and the cord makes two wide loops (1, 2) around the rod, the cord passing under the knotted end. The first loop makes the first transverse turn (*f*, 1) around the rod and passes over the knotted end. The second loop makes a second transverse turn (*g*, 2) around the rod above the first turn and passes over the knotted end. In *h*, the end is pulled downward to remove the slack and cut off to complete the double overhand knot lashing.

A series of variations of the overhand technique as applied to lashing two cross pieces is shown in figure 82, *a-e* and described below.

In *a* is shown the double overhand knot already described (fig. 81). The paired overhand is shown in *b* and *c*. The first overhand turn (*b*, 1) is completed and the coil carried over the right upper corner. The second oblique turn (*c*, 2) is completed like the first and the cord (3) may be carried on to the next lashing.

The crossed overhand technique is shown in *d* and *e*. An oblique overhand turn (*d*, 1) is made around the right upper and the left lower corners, drawn taut, and the cord diverged to the left upper corner. In *e*, the cord completes the second oblique turn (2) around opposite corners and passes under the upper part of the second turn, whence it may continue to the next lashing.

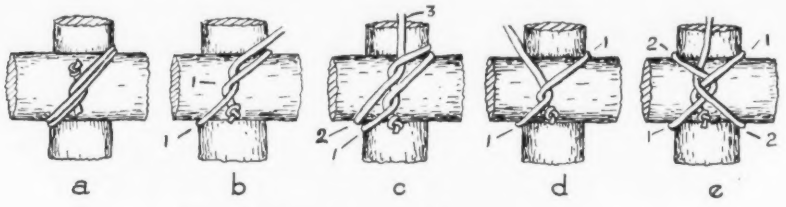

FIGURE 82.—*a-e*, overhand knot variations.

The crossed overhand technique is used as a continuous series in lashing the crossed rods of fish traps (*u*), when it is termed *hiri* or, in full, *ti hiri o ti u*. It is also used in lashing the horizontal bars to the vertical rods in house walls (*apaapa*).

SEIZING

Seizing (*riri*) consists of close transverse turns made around a rod or the shank of a fishhook and around the stretches of long turns of lashings to brace them together. The round turns are made in four different ways.

The simplest form consists of continuous round turns without any knots or hitches. This is used in bracing together the straight turns in the canoe lashings between the top strake and the hull and similar lashings. After making a sufficient number of long turns, the cord is simply wound around them, the last two rounds being made large; the cord end passed back through them; the rounds tautened; the slack pulled out; and the cord cut (fig. 83, *a*).

The overhand hitch seizing is so termed by me because each turn is tied with an overhand knot technique though in reality forming an overhand hitch. It is used in the fastening of the snood to the fishhook shank and is then referred to as *ti riri matau* (the hook seizing). The formation of overhand hitches is shown in figure 83, *b*, *c*. In figure 83, *b*, the knotted end is held down against the shank with the left thumb and the cord makes a transverse turn toward the right, appears on the left, passes over the knotted end, and then under the loop from below. The slack is drawn out and successive turns are

made in the same way. A variation has the turns directed first toward the left (fig. 83, *c*).

The underhand hitch seizing differs from the overhand in that in the series of turns the cord passes under and then over the loops formed by the bight of the cord. This form is also used in lashing the snood of fishhooks. In the first turn (fig. 83, *d*, 1, 1), the cord passes over the knotted end to form an overhand knot to fix the commencement of the seizing. In the next turn (*2*, *2*), the cord passes under and then over the loop formed by its bight which is the opposite to the overhand hitches in *b* and *c*. The following turns follow the technique established by the second turn (*2*, *2*).

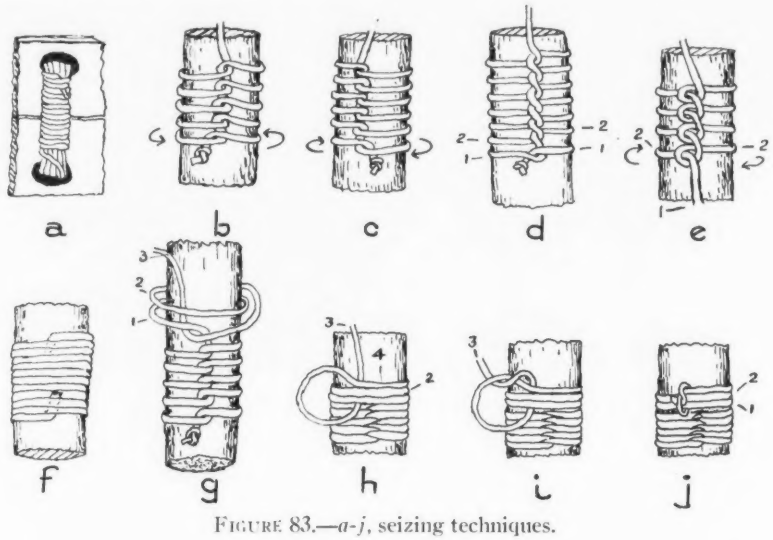

FIGURE 83.—*a-j*, seizing techniques.

The crossing hitch seizing is an application of what Ashley (1, p. 40, fig. 206) has termed the crossing knot. This knot is used in the wrapping of preserved breadfruit (fig. 24) and in close transverse turns in the snood lashing of wooden hooks (fig. 144, *g*). The technique is shown in figure 83, *e*, wherein the cord (1) turns to the left to make a transverse turn (*2*, *2*) around the shank. The cord coming in from the right passes over and under the standing part (1) and then over the turn (*2*) on the right. This is repeated in the following turns.

A more intricate form of double seizing was used in attaching the shell point to the staff of a pump drill. A long cord was tied at its middle with an overhand knot around the shell point and the lower end of the shaft. The right limb of the cord made alternate turns around the shaft and each turn was fixed on the right side with an overhand hitch, as in figure 83, *b*. The left limb made alternate turns with overhand hitches on the left side of the shaft, as in

figure 83, *c*. After close turns were made upward for one inch, the turns worked downward over the first layer. Each string continued the alternate turns but made crossing hitches, as in figure 83, *c*, on their respective sides.

The seizing commencement was usually fixed with an overhand knot as in figure 83, *b-d*; but in the form of simple continuous rounds, the commencement end was bent upward and covered by the subsequent turns, as in figure 83, *f*.

The end fixation was usually made with one or two overhand knots but in the overhand hitch technique (fig. 83, *b, c*) the end was simply cut off. In the simple continuous round seizing, the end was passed back under one or two looped rounds, as in figure 83, *f*. However, a more secure fixation could be applied to all forms of seizing, as shown in figure 83, *g-j*. An overhand hitch seizing is shown with the knotted end on the left (fig. 83, *g*). The turns are spaced a little to illustrate the overhand hitches. To fix the end, two wide loops (1, 2) are made around the shank, and the cord (3) with its coil, if such is used, is passed from the left through the two loops. The loops (*h*, 2) are drawn taut, and the slack (4) drawn taut beside the second turn (2) until it crosses the cord (3).

The cord (*i*, 3) is passed over and through the slack loop to insure an overhand knot. The slack is drawn taut and the cord completes the overhand knot around the two turns (*j*, 1, 2).

LASHING PATTERNS

The verb *hau* means to lash two wooden parts together; but the noun, *haunga*, is applied only to lashings in which the crossing turns form patterns which are generically termed *humu*. Two patterns in common use are the lozenge and the ellipse (fig. 84, *b, c*), both referred to as *humu* without any specific term to distinguish between them. A third pattern is the multiple chevron (fig. 84, *d*). All three patterns are extensively used in Polynesia.

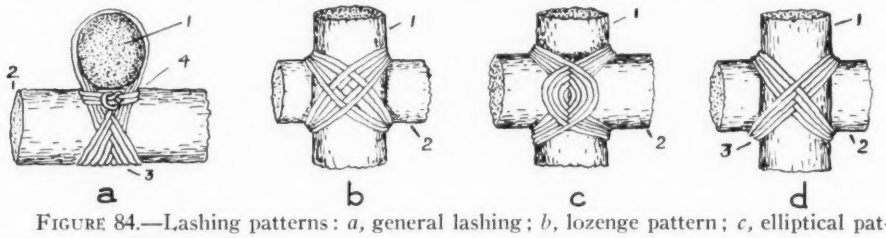

FIGURE 84.—Lashing patterns: *a*, general lashing; *b*, lozenge pattern; *c*, elliptical pattern; *d*, ascending chevron.

In Kapingamarangi, the lozenge and the ellipse patterns are complementary to each other, as in the lashing of the main rafters to the ridgepole (fig. 34) and of the tie beam to the tie-beam plate (fig. 84). The techniques of these two patterns and the multiple chevron patterns are shown in figure 84, *a-d* and described as follows:

The tie beam (*a*, 1) rests on the plate (2) and the lashing is commenced with the overlaid technique to form the lozenge pattern on the upper surface of the tie beam. The crossing turns pass downward around the plate to form the ellipse pattern (3) on its under surface. When the patterns are completed with two sets of five crossing turns, two circumferential turns (4) are made around the lashing turns where they pass between the tie beam and the plate to tighten up the lashing, and the cord is then tied around these two horizontal turns with an overhand knot.

The lozenge pattern (*b*) on the upper surface of the tie beam is composed of five turns each way, commencing with two oblique turns crossing in the middle and successive turns on either side above and then below.

The elliptical pattern (*c*) on the underside of the tie-beam plate looking upward from the floor consists of five curves each way as shown in the ridgepole lashing.

The chevron pattern (*d*) is used in the lashing of the longitudinal stringer (1) to the crossbooms (2) of a canoe. After making the lowest crossings (3) with the first turns from either side, the following crossings are made on the upper side of the preceding pair. This creates a series of ascending chevrons. If the first crossing pair is made higher up and the succeeding pairs below, a series of descending chevrons will be made.

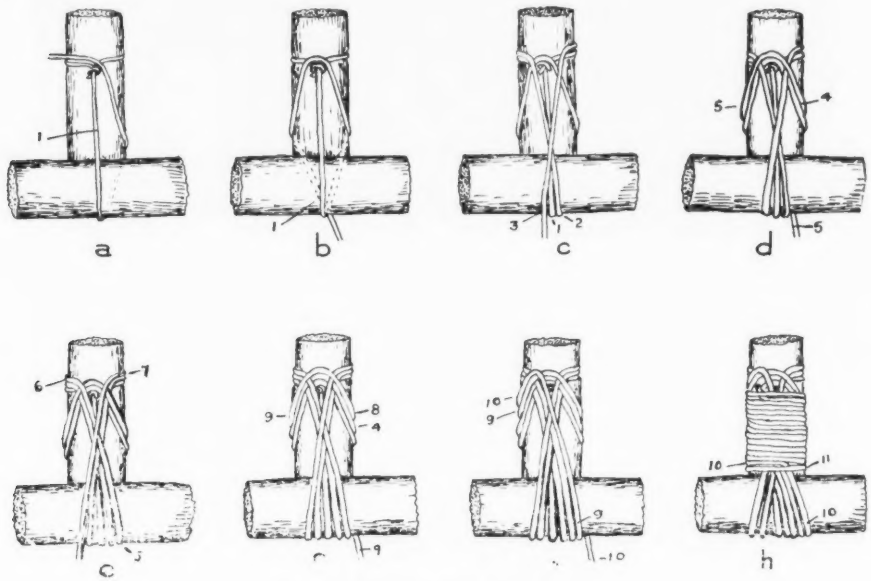

FIGURE 85.—*a-h*, T-join lashing.

THE T-JOIN LASHING

The T-join lashing termed *ti hau ni hou* is used to lash a stick or rod to a cross bar but the end of the rod is placed against the cross bar and does not overlap it. It is used in the *tauwene* fish nets and in lashing thatch rafters to the eaves batten when the pierced method is not used. A transverse groove is cut in the rod an inch or so from its end as a preliminary. The various stages are shown in figure 85, *a-h* and described below.

In *a*, the end of the cord is tied in a noose around the groove in the rod and drawn taut with the knot in the middle of what may be termed the front surface. The cord (1) is passed vertically downward around the cross bar, turns obliquely to the right at the back, and ascends on the right side of the rod to cross above the knot in the middle line.

In *b*, from above the knot, the cord descends obliquely on the left of the rod, turns obliquely on the back of the cross bar to cross the previous back turn and appears on the lower side of the bar on the right of the first vertical turn (1). The cord forms an oblique turn (*c*, 2) over the front of the bar, crosses the vertical turn (1), ascends on the rod toward the left to reach a position above the transverse turn of the noose, passes transversely around the back of the rod above the transverse turn, appears on the right of the rod and makes an oblique turn (3) downward to cross around the bar on the left of the vertical turn (1).

From the left, as shown in *d*, the cord passes obliquely to the right on the back of the bar and, following the previous turn in that direction, appears on the right of the rod (4), follows the previous turn above the knot, descends on the left (5), crosses to the right behind the rod and the bar, and appears on the lower border (5) to the right of the previous turns. The cord (*e*, 5) now follows a course similar to that in *c*, ascending obliquely to the left (6), passes around the back of the rod, appears on the right (7) and descends in an oblique turn to the left (7) of the previous turns around the bar.

From the left, as shown in *f*, the cord passes obliquely to the right at the back of the bar keeping above the previous turn (4), appears on the right of the rod (8), forms the upper loop, descends on the left (9), and continues obliquely across the back to appear at the lower border of the bar on the right (9) of the previous turns.

From the right, the cord (*g*, 9) ascends obliquely to the left, but instead of passing around the rod, it descends above the previous turn (9) and continuing this relationship it crosses obliquely at the back to reappear on the right (10) of the previous turns around the bar.

From the right (see *h*), the cord passes obliquely upward on the bar, but on reaching the rod, it passes transversely to the left and after one turn (11) below it, it makes seizing turns upward to secure the oblique lashing turns and is fixed at the upper end by passing under the last transverse turn.

This lashing is firm and secure, and somewhat unique, as far as my experience goes.

LASHINGS THROUGH HOLES

Lashings through holes in two pieces of timber are used in attaching the washstrake to the underbody or hull of canoes. As a similar technique is used throughout Polynesia, and as both the pump drill and chisels are used on the atoll, it appears certain that this form of lashing is old for Kapingamarangi. Individual lashings through paired holes are termed *mataha*. The commencement end of the cord is fixed by the overlaid turns which pass vertically between the two holes. In some lashings, these vertical turns are considered sufficient, whereas in others, the vertical turns are seized (*riri*) with simple continuous rounds, sometimes on one side only and sometimes on both sides (fig. 86, *a*).

A variation is used in the lashing of the washstrake to the hull, in which there is one hole below the midpoint between two holes in the washstrake. All

the lashing turns pass through the hull hole and alternately between the two holes in the washstrake. This results in a V-shaped pattern which is termed *mataha mangarua* (*mangarua*, two branches). Usually, each limb of the V-lashing is seized with simple continuous rounds (fig. 86, *b*).

The use of holes to form *mataha* and *mataha mangarua* lashings in the attachment of the main rafters to the tie beam and in other parts of the house framework are modern applications of an old technique encouraged by the ease with which holes can be bored with steel points.

The T-join lashing (*hau ni hou*) of the thatch rafters to the eaves batten is now usually made by passing the longitudinal turns through a hole in the rafter and around the batten. The turns are then seized on both sides with the simple continuous round turns (fig. 86, *c*).

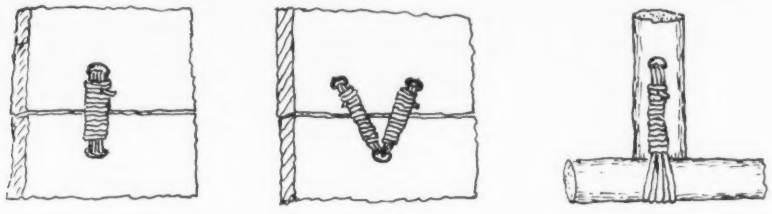

FIGURE 86.—*a-c*, lashings through holes.

CLOTHING

INTRODUCTION

Garments, in general termed *kahu*, formerly consisted of plaited pandanus leaf, bark cloth, and cloth woven on a loom. The introduction of trade cloth has done away with the original garments, though some native woven material is seen in use.

Men formerly wore the loin cloth made of breadfruit bast. It retained the Polynesian name of *maro* under the dialetical form of *mara* and was qualified by the name of breadfruit (*kuru*) material as *mara kuru*. It is probable that they also wore the woven cloth in the form of a loin cloth, but woven cloth is generally regarded as women's clothing. A plaited mat is sometimes worn as a kilt or skirt.

Women, according to informants, did not wear bark cloth. They wore a skirt termed *teru*, usually pronounced *seru*, woven from hibiscus bast (hau) and specifically termed *mara hau*. It is curious that the term *mara* (*maro*) which means a loin cloth worn only by men, should have been applied to a skirt used by women. When working in the *puraka* cultivations, they wore a skirt made of plaited pandanus leaf. The short skirts made of coconut leaflets

and so common in the Polynesian atolls were not made, but informants stated that they were worn by a Nauru woman married to a European (*parangi*), who lived on the atoll.

Sandals were not used in former times, but since the Japanese occupation they are made out of native material. A coconut-leaf hat is made, mostly as an eyeshade, and a conical hat of pandanus leaf is still made for use by fishermen when torching for flying fish. Garments were plaited by women, but the pandanus hat was plaited by men. Curiously enough, both bark cloth and loom-woven textiles were made by men.

PLAITED GARMENTS

A garment plaited by women from pandanus leaf was worn as a skirt (*teru*) by women working in the *puraka* cultivations. One made for the Museum is 46 inches long and 24 inches wide with seven wefts to the inch. It was made with the same technique as the general pandanus mats as regards commencement, check plait, side edges, and finish. Pandanus mats are termed *kahara* in general, and, since the garment is small (*turi*) as compared with other mats, it is termed *kahara turi*.

A narrow-wefted pandanus mat garment, termed a *kahara tangata* is said to have been a *kahu tangata* (*kahu*, garment). Though *tangata* means a human being of either sex, in the above sense it was applied to males. I asked if it was a narrow band like the plaited *maro* of Polynesian atolls, but Alfred Patterson said it was not. Ti Rongorongo, the head craftsman on the two canoes we saw being dubbed out, wore a mat as a skirt (fig. 4), so it seems that the *kahara tangata* was merely the male form of the women's *kahara turi*.

BARK CLOTH

It is interesting to find that bark cloth was made on an atoll in Micronesia, for none of the Polynesian atolls were able to grow the paper mulberry, breadfruit, and banyan which provided the material for making bark cloth in the high islands of Polynesia. Something in the soil or the rainfall of Kapingamarangi renders the growth of the breadfruit possible, hence the inhabitants of that atoll are more fortunate than their atoll-dwelling kinsmen in Polynesia.

Certain differences in the Kapingamarangi and Polynesian methods of making bark cloth may be noted. The first is the lack of grooves in the beaters and the round form of the anvil, but, as those we saw used were makeshift implements, they may have been different in former times. Another difference is the use of bark from large saplings so that one strip is large enough to form a complete garment. Hence there was no necessity for a technique to join pieces together.

In Polynesia, it is usual to strip the entire bark from small rods and then separate the outer skin from the bast in contrast to the local method of scraping off the outer bark before the bast is stripped from the wood. The procedure of washing and then wringing by mechanical means with a stick and stake is not used in Polynesia. And, lastly, informants hold that native dyes were unknown.

Though the current use of bark cloth has ceased, many of the old men remember the details of manufacture quite well. One of them named Mairiku demonstrated the process after Hetata brought two breadfruit trunks from Hare for the demonstration. The piece selected was 4 inches in diameter at the butt end and 8 feet 6 inches in length.

The first step consisted of scraping off (*haru*) the outer layer of bark from the log, and Mairiku used the blade of a steel hatchet for the purpose. He did not know what was used as a scraper before the introduction of metal, for metal tools were the only ones he had known from the days of his youth. I assume that a shell adz or the pearl-shell cutter (*taku*) was used in former times. The breadfruit trunk was laid on a coconut-leaf mat (*hinai*), upon which he sat and scraped away at the bark, commencing at the butt end. He worked on a length of about a foot, scraping toward himself and turning the log around until its full circumference was completed, then commenced another short section. By repeated scraping, the whole length of the log was denuded of its green outer bark and the white inner bast fully exposed.

The next step, termed *hahi*, was to strip the bast off the wood. With the corner of the hatchet edge, Mairiku incised the bast down to the wood in a straight line the length of the log. With the hatchet, he then prized the edges loose from the wood on one side and then on the other. Having completed this throughout the length of the incision, he worked around the butt end so as to separate the edge of the bast around the circumference. Turning the log over with the longitudinal slit underneath, he gripped the separated butt end of the bast and, by pulling upward, detached the bast gradually until it was completely separated from the wood in one sheet. (See figure 87, *a*.) The detached sheet of bast was 8 feet 6 inches long, 10.75 inches wide at the butt end, and 7.5 inches wide at the other end; the thickness of the bast layer, 2 millimeters. The strip was laid out on the coral gravel to dry in the sun: *ka toho ki ti ra ki mango*.

Mairiku took the bast home with him to keep until the next day's work. However, as two wet days and Sunday intervened, he did not resume operations until the following Monday. On Monday morning, Mairiku soaked the bast in the lagoon for an hour, then turned up at our quarters with it and two primitive-looking beaters and a makeshift anvil (fig. 88).

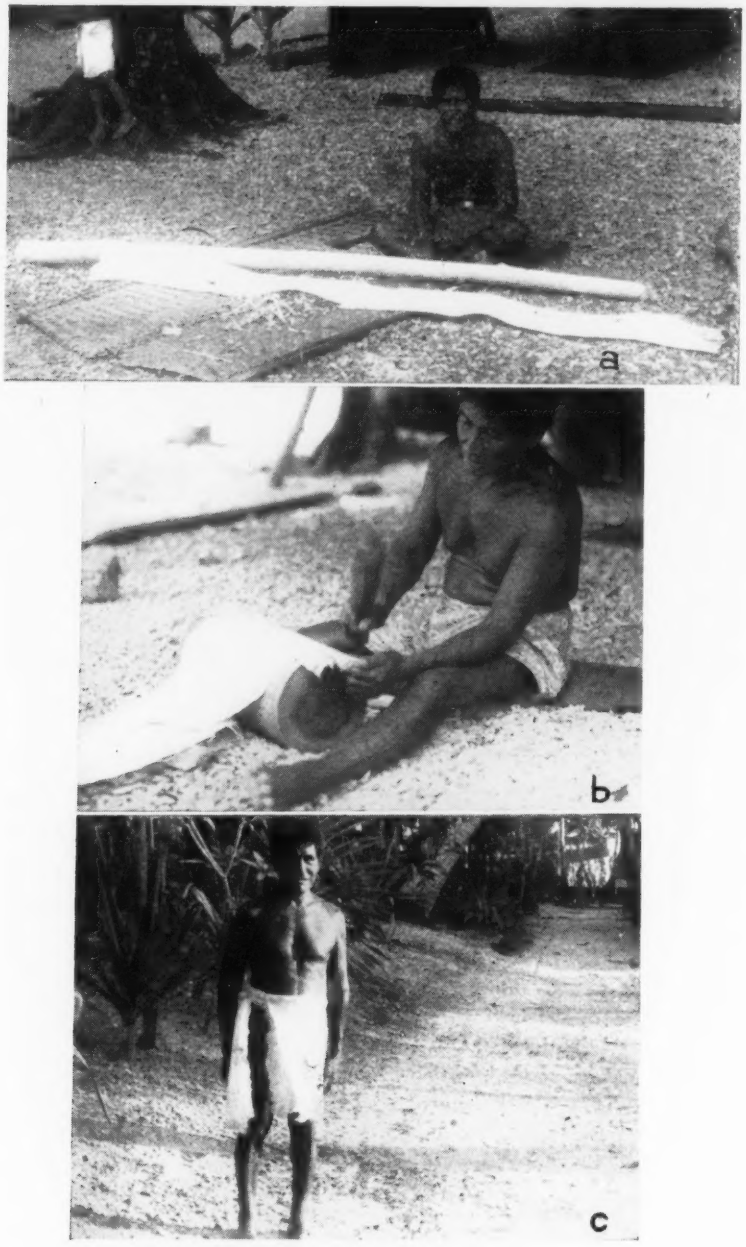

FIGURE 87.—Bark cloth: *a*, Mairiku with bast strip; *b*, beating the bast; *c*, wearing malo.

Beaters and Anvils

If there were carefully made beaters in olden times, they have been forgotten, and no pattern has survived to be copied. Of the two hastily made beaters, the larger (C.10006) was of coconut wood, 15 inches long, and roughly shaped with a wide truncated end, 3.5 inches wide by 2.5 inches thick. The other end was shaped into a rounded handle, 1.5 inches in diameter (fig. 88, *b*). It had been used for other purposes, such as beating coconut husk, and was without the longitudinal grooves so characteristic of Polynesian tapa beaters.

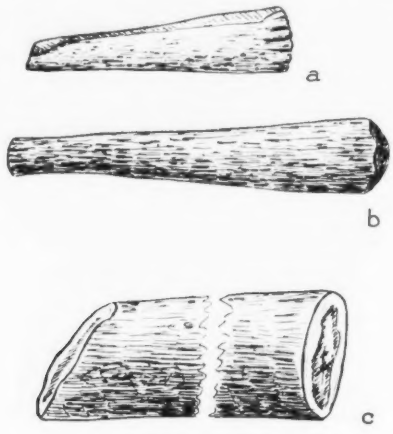

Figure 88.—*a*, *b*, beaters; *c*, anvil.

The smaller beater had been newly made for the occasion from a piece of pandanus wood. It was 10.5 inches long, 2.7 inches wide at the distal end, and 1.4 inches thick. The end of the handle was roughly shaped to an inch square. The smooth, outer surface of the pandanus trunk formed the beating surface (fig. 88, *a*). The beaters were called *tuki* which applies to any beater or pounder.

The anvil was formed of a section of solid pandanus trunk, perfectly round and smooth and 8.5 inches in circumference. The section was sloped at one end for no particular purpose, the length thus being 19 inches on one side and 23 inches on the other (fig. 88, *c*). The anvil had no specific name but was simply called *ti hara* (the pandanus).

Beating Process

The beating of the bast is termed *ta* or *tuki*. Probably the term *tuki* applies more correctly to pounding or mashing with the end of a pounder, whereas *ta* conveys the meaning of striking with the side of the beater and thus applies more closely to the beating of the bast.

Mairiku laid the wider end of the bast sheet over the anvil, which was laid crosswise before him on the ground. He commenced tapping the bast in a line from right to left about 8 inches from the end, using the narrower side of the larger beater. Having marked off a section, he tapped down the right edge and thus worked in longitudinal lines across the section (fig. 87, *b*). The bast, which, after drying and soaking, was 8 inches wide at the wider end, increased in width to 13.5 inches after the first beating. Mairiku pulled the completed part toward him and commenced beating the next section, about a foot in length. He continued patiently with his regular tapping until the whole length of the sheet had been beaten.

Next, Mairiku went over the work carefully with the lighter beater, paying particular attention to thicker parts. At the end of the second beating, the sheet at the wide end had increased from 13.5 inches to 18 inches. He folded the sheet into four or five thicknesses and beat them down, sometimes using the heavy beater. This last beating was for the purpose of thinning down the bast even more or, from the practical view, beating to increase the width (*e tuki ki ngatoro*). At the end of this final beating, the width of the sheet had increased from 18 to 23 inches.

Washing

Washing (*noku*) was the next step, and the beaten sheet was taken to a convenient pool of salt water on the sea side of the island. Mairiku dipped the sheet in the pool and rubbed it with his hands as if he were washing clothes. After rubbing, the cloth was spread out to its full length and then drawn through the left hand to squeeze out the water, the action being termed *muhi*. It was then twisted with both hands to wring out the water, an action termed *tau*. This over, Mairiku came ashore and we returned to our quarters for the next stage.

Mairiku set up a smooth stake about 1.5 inches in diameter by planting the lower end in the ground and tying the upper end to the branch of a pandanus tree. He passed the strip of cloth around the stake and the two ends were overlapped to form a continuous band. The ends were simply folded into the cloth without any knots. The band was twisted closely by hand from the stake outward. A loop was formed at the outer end into which a short stick was inserted. Using the stick with both hands, Mairiku proceeded to twist the cloth, and the water poured out in quantity. The twisting continued for the length of the cloth; and, as it continued, the twisted cloth buckled up into a close mass beside the vertical stake. Still not satisfied, Mairiku untwisted the band by reversing the turns of the stick and moved it round on the stake. He then twisted the whole band again, and more water flowed out.

When the band was untwisted and the ends loosened, Mairiku held an end of the cloth in each hand and drew it backward and forward on the stake to smooth it out by rubbing, which is termed *hara*. He then slipped the cloth from the stake, opened it out, and spread it for its full length on the clean coral gravel, stretching the damp cloth out laterally with his hands to remove the folds and creases. Particular attention was paid to the side edges (*taringa*), even to pulling out parts to form fringes. The stretching process is termed *horohoro*.

When satisfied that all folds had been straightened out, Mairiku spread the cloth out in the sun (*toho ki ti ra*) to dry. In spite of the rubbing and stretching, the wringing had reduced the width of the cloth from 23 inches to 20 inches.

Mairiku returned in two hours and announced that the cloth was dry. It took some gentle persuasion to get him to discard his trousers and shirt temporarily and don the old time garment which he had made. The cloth was too wide in a single sheet so he doubled it lengthwise, thus forming a strip 10 inches wide. Holding one end under his chin, he passed the cloth back between his legs, brought it round to the front from the right side, crossed the front end, still held vertically, passed it around the waist, and hooked the end on the right side. He lifted his chin and the other end dropped down in front like a neat white apron. Thus attired, he shyly came out of the house to have his photograph taken. Figure 87, *c* shows that he still carried an air of embarrassment. The cloth and the manner of wearing it illustrate one of the many features which link the people of Kapingamarangi with their blood kin in Polynesia.

Forms of Loin Cloth

The *mara* was worn in different lengths for different purposes. The *mara hunu aka i rara* (loin cloth which hides from below) was a short piece long enough for the ends to be suspended fore and aft by a cord (*tirahira*) which passed around the waist. It was used as a working garment in the plantations or out fishing. A piece of calico is often used in the same way at the present time by both adults and children. Sometimes the cloth *mara* are rather wide, with a baggy appearance, but often pieces barely wide enough are used by fishermen.

A curious change in vowels is illustrated by the descriptive name of the short loin cloth when compared with the general Polynesian words as follows: Kapingamarangi, *mara hunu aka i rara*; Polynesia, *maro huna ake i raro*.

In the *mara rawa tahi* (loin cloth sufficient for once), the length was sufficient to pass back between the legs and pass around the waist once (*tahi*). This was the form worn by Mairiku.

In the *mara rawa rua* (loin cloth sufficient for twice), the cloth was long enough to go twice (*rua*) around the waist. This term may be repeated by using the number to denote how many turns the cloth made around the waist.

After returning from work in the field or from fishing, the individual changed his clothes. This implied or included washing (*kaukau*), drying (*hakamango*), and putting on clothes (*tara*). The term *hakamango* has come to be used idiomatically to include all three stages. Thus, with the imperative suffix *ina*, *hakamangoina koe* means dress yourself.

LOOM WEAVING

Introduction

Loom weaving is essentially a Micronesian craft which spread beyond the bounds of Micronesia to Santa Cruz and to some Polynesian outliers in Melanesia but never reached Polynesia proper. It was described by the German Expedition as being present in Nukuoro and in Kapingamarangi, where the growth of wild hibiscus (hau), which does not grow on the Polynesian atolls, supplied weaving material. Curiously enough, the weaving was done by men. In Nukuoro to the north, where a sufficient growth of banana plants provided an alternate fiber for weaving, the women operated the looms. Though the banana also grew in the moist *puraka* cultivations of Kapingamarangi, the supply was evidently too small to lead to its fiber being used for weaving.

Though the Kapingamarangi loom with its parts resembles that of Truk, the terms used for the parts are totally different and there is no evidence that any of the Kapingamarangi terms were derived from those of Truk. The loom occurs in some of the Polynesian outliers in Melanesia and a study of its distribution would be valuable. A study of the distribution of the breadfruit, wild hibiscus, and banana would help to shed light on the bark cloth and weaving problems, but care would have to be taken in discriminating between early and late diffusion. It is evident that, like the conical hat, the loom came into Micronesia from the west, spread to some of the Polynesian outliers, reached Santa Cruz in Melanesia, but did not travel as far as Polynesia.

It was a pleasant surprise to find that loom weaving was still practiced by a number of men on Kapingamarangi and that several looms, rolled up in pandanus mats, were stored in the lofts of the canoe houses. The first loom seen in operation was owned by Piripi, and a second one was worked by Tawhera. The various stages of weaving were observed on these two looms, and I was given the opportunity of practicing on Tawhera's loom in order to become more intimately acquainted with the practical as well as the theoretical details. Though the various stages of weaving were not all observed in their proper sequence, they are so arranged in this description. The procuring and treat-

ment of the hau bark was stage-managed in order to complete the full description from the preparation of the material to the final completion of the woven textile.

Hau Bast

Arrangements were made with Hetata to procure some hau bark to illustrate the preliminary stages of preparing the material for the warps and wefts. He obtained permission from a resident of Werua to take a convenient hau tree growing on his property, an old spreading tree with straight shoots growing from the base. A sapling was selected about 6 inches in circumference at the base, and about a quarter of its thickness was cut through with a shell adz. Having proved the efficiency of the adz, a steel hatchet was used to cut through the rest, except for the last blows, for which the shell adz was again used. The end of the sapling was cut off, leaving a length of 15 feet.

The next stage was the *hara* process of trimming off the outer green bark from the trunk in the same way that the outer bark was removed from breadfruit saplings in the making of bark cloth. Part of this was done with the shell adz, the thin peeling strokes being made toward the worker. Work was commenced at the butt end. The shell adz was effective, but slower than a steel implement, so I took pity on Hetata and allowed him to use a steel knife, which he preferred. With the knife, he sliced off the outer bark with strokes directed away from the body.

The whole length of the sapling having been denuded of its outer green bark, attention was directed toward the removal of the white inner bast. The bast was cut through to the wood in its full circumference at about the middle of the sapling. A longitudinal incision the length of the trunk was then made and the edges were prized up with the shell adz. At the half-way mark, the bast was completely separated from the wood by working around the cross cut. The sapling was turned over with the long slit underneath. Seizing the end with the completely separated bark, Hetata pulled up from the wood and the bast peeled off readily in one complete sheet. The other end of the sapling was treated similarly. The two bast sheets were each cut into three equal sections and taken home to Touhou for further treatment.

At Touhou, the bast was soaked in the lagoon (*tuku ki tai*). A suitable spot having been selected in the shallow water offshore, Hetata scraped away the sand at the bottom to form a bed for the strips of bast. A thin layer of sand was scraped back over the bast, and an old coconut-leaf mat of the *hinai* variety was laid over the spot on the bottom of the lagoon. Large pieces of coral held down each corner of the mat, and the bast was left to soak for the required two weeks or more.

The submerged bast was declared mature after two weeks, and the pieces were laid on the coral gravel beside our quarters to dry in the sun. The dried

strips were then put away until it was convenient to continue the next stage, which was done on the following day.

Preparation of Warps and Wefts

The dried bast strips separated easily into thin layers. Hetata went over them carefully, and pieces that were stained or ragged were cast aside as rubbish (*keinga*). Our material was very white, as it came from a young sapling, whereas the bast from older trees is a deeper, tan color. Hetata took up a single thin layer of bast and, with his thumbnail, split off (*kini*) a narrow strip about 2 millimeters wide from one end of the wider piece. He inserted his left forefinger in the split and ran it down the length of the piece to separate the narrow strip completely. Throughout this process, which is termed *ihi*, Hetata attempted to keep the strip to the even width of 2 millimeters. If the strip, or thread, was too wide, the extra part was neatly split off. Any ragged fibers, termed *taraha*, were trimmed off with the fingers. As each thread was split off, it was laid on the ground until a sufficient quantity had been provided.

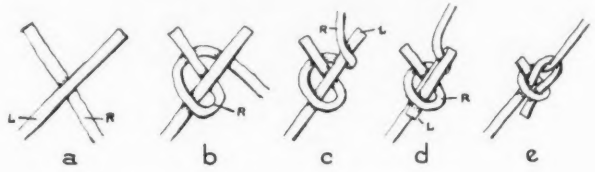

Figure 89.—*a-e*, the weaver's knot.

The individual threads, termed *konchanga*, were joined together (*tutaki*) with a local form of weaver's knot to make a continuous thread. The technique of the knot, shown in figure 89, *a-e*, is described as follows:

> The ends of two threads are crossed with the right thread under the left thread (*a*); the standing part of the right thread is looped around and beneath the two ends (*b*); and the right thread is turned back over the end of the left thread (*c*). The end of the left thread is then doubled back on itself and passed under the loop of the right thread (*d*). Holding down the doubled left thread with the left thumb, the right hand pulls the standing part of the right thread so as to close the loop and complete the knot (*e*).

The above technique may be reversed by placing the end of the left thread underneath with equally satisfactory results. The weaver's knot is used throughout the process of weaving in joining snapped warps and wefts.

As the knots were made, any extra length in the ends was pinched off and the knots squeezed with the right finger and thumb to flatten them. The continuous length of thread was coiled in a coconut-leaf round basket (*kata*), where it was kept for the next stage, in which the warps were set up and the shuttle loaded.

Setting Up Warps

A special apparatus termed *ti waka mara* is used in setting up the warps to form what is termed the web. It consists of a thick beam with a number of holes into which four removable uprights are inserted. The beam used in the demonstration of the technique was 8 feet 4 inches long, 6.4 inches wide, and 4.25 inches thick. It had eight holes set along the middle line of the upper surface and spaced as shown in figure 90, *a*. The first hole on the left and the five holes on the right were 2.5 inches in diameter and were pierced right through the beam. Of the four uprights used, three are always inserted in the first three holes on the left (fig. 90, *a*, 1-3) and the fourth upright may be inserted in any one of the five holes on the right, depending upon the length of cloth desired. As the removable uprights give place later to permanent elements of the loom, it is convenient to modify the word stick with the loom names.

The first stick, inserted in hole 1 on the left, was a stout round piece 3.5 inches in diameter with the lower end trimmed to a diameter of 2.5 inches for a depth of 4.25 inches so as to fit into the hole in the beam. It was termed a *turuturu mara* and may be referred to as the cloth stick (fig. 90, *b*, 1). The cloth stick was 15.5 inches from the left end of the beam.

A second stick similar to the cloth stick was inserted in the middle hole (4) of the five holes on the right of the beam (fig. 90, *b*, 4). It is also termed a *turuturu mara*, but it may be distinguished from the cloth stick by the term warp stick.

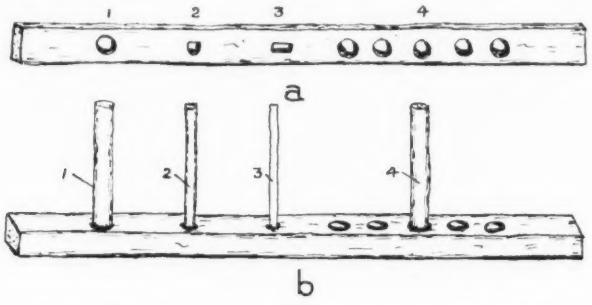

Figure 90.—*a*, *waka mara* beam; *b*, with loom sticks.

The warp stick and the cloth stick, which form the end uprights around which the turns of the warp thread are wound, determine the length of the cloth. The distance between them in this case was 55.5 inches and thus made possible a cloth 111 inches long, including the end fringes. If a short length of cloth is desired, the warp stick is moved to a hole on the left; if a longer piece is wanted, the warp stick is shifted to the right.

The third stick was flat on the far side and rounded on the near side, the diameter from far to near being 1.75 inches and from side to side, 1.25 inches. It was fitted into hole *2* which was shaped to receive it. It is called *rakau tiroahi* (stick for the odd rounds) and may be termed the heddle stick (fig. 90, *b*, *2*). The distance between the cloth stick and the heddle stick was 15.5 inches.

The fourth stick was a slender rectangular rod, 0.5 inch wide and slightly less in thickness which was fitted into hole *3*, also shaped to receive it. It is termed *rakau hae mara* and may be referred to as the laze stick (fig. 90, *b*, *3*). The distance between the heddle stick and the laze stick was 15 inches and between the laze stick and the warp stick on the right, 25 inches.

FIGURE 91.—Three men setting up warps.

The thread consisted of the continuous hibiscus bast strips, *2* mm. wide, knotted together with the weaver's knot, and coiled up in the round coconut-leaf basket as demonstrated by Hetata.

A small netting needle loaded with a thin two-ply cord is a necessary part of the equipment. The thread was formerly made of breadfruit bast, but now trade thread is used. This small netting needle is not to be confused with the large shuttle later used with the weft thread.

The operators were three men, two seated on the ground on the near side of the beam and one on the far side (fig. 91). The operators and their functions are described by Alfred Patterson below.

The man on the near side to the right (left in picture) sits beside the round basket containing the thread (*katahanga*), which in the picture is concealed by his body. He is termed *ti tangata hakamatama ti katahanga* (the man who clears, *hakamatama*, the thread in the basket of thread, *katahanga*). He pays out the thread from the basket to prevent tangling (*hinihini*).

The man on the far side (right) of the beam is termed *ti tangata taki nia konchanga o ti mara hau* (the man who guides the threads of the hau garment). The thread is passed from the round basket over a tie beam or horizontal pole to keep it off the gravel floor, and the man who may be termed the winder passes the thread around the four upright sticks on the beam. Sometimes an extra man stands under the horizontal pole to see that the thread runs smoothly over the pole, and he removes any tangles that escape the man in charge of the basket. He sees that the thread descends from the pole into the hands of the winder.

The third man sits near the heddle stick and is termed *ti tangata tiri tiroahi* (the man who makes *tiroahi* loops). He is armed with the loaded netting needle with which to make the *tiroahi* loops on each side of the heddle stick. For convenience, he will be termed the netter. The extra person in figure 91 is a spectator.

The thread is passed from the basket over the beam and the winder ties the end in a running noose to the bottom of the warp stick which is on his left. He then makes continuous rounds around the end sticks, from left to right on his side and from right to left on the netter's side. On the winder's side, the thread has a straight, uninterrupted run but on the netter's side, the heddle stick and the laze stick are used to separate the odd and even rounds. This is done by the netter making loops with his netting needle around the odd turns (*tiroahi*) as they pass the heddle stick and by the winder passing the turns alternately on the far and the near sides of the laze stick.

The following details of the turns on the near side are shown in figure 92 *a*.

The cloth stick (1) is on the left, the warp stick (4) on the right, and the heddle stick (2) and laze stick (3) in their respective positions. The first round (1′) on the near side comes around the cloth stick and passes on the far side of the heddle stick. As it is the first odd round, the netter ties the thread of his netting needle to it on the right side of the heddle stick. At the same time, he calls "*tiroahi*" (odd round), and the winder passes the warp thread on the far side of the laze stick. The warp round (1′) passes around the warp stick on its near side and makes a long uninterrupted stretch on the far side of the end sticks. The thread reappears as the second round (2′) on the near side of the cloth stick, passes on the far side of the heddle stick, the netter calls "*toro*" (even), and the winder passes the thread on the near side of the laze stick, from which it passes around the warp stick, makes the straight far stretch and reappears on the near side of the cloth stick to start the third round (3′). Meanwhile the netter has laid his netting needle on the second round (2′) on the left of the heddle stick. As the third round (3′) passes on the far side of the heddle stick, the netter hooks the netting needle around it, calls "*tiroahi*" (odd), the winder passes the warp thread on the far side of

the laze stick and on around the warp stick. The netter lets the fourth round (4′) go, calls "*toro*" (even), and the winder passes the warp on the near side of the laze stick. The netter rests his needle on the fourth round on the right side of the heddle stick, and when the fifth round (5′) passes it, he hooks the netting needle around it to form a loop. He calls "*tiroahi*" and the thread passes on the far side of the laze stick.

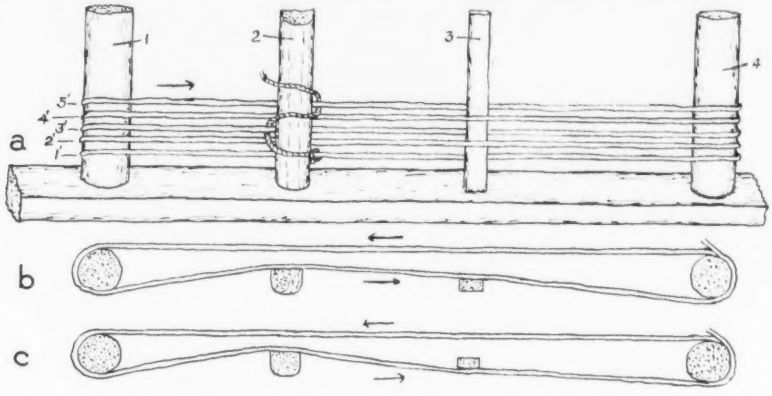

FIGURE 92.—*a-c*, separation of odd and even rounds.

The above technique is continued for the depth of the warp web. The odd rounds (*tiroahi*) commencing from the first (fig. 92, *a*, 1′), are caught in loops alternately on the left and right sides of the heddle stick and all odd rounds pass on the far side of the laze stick. All even rounds (*toro*) pass on the far side of the heddle stick and the near side of the laze stick (fig. 92, *a*). Viewed from above, an odd round is shown in figure 92, *b* and an even round in figure 92, *c*.

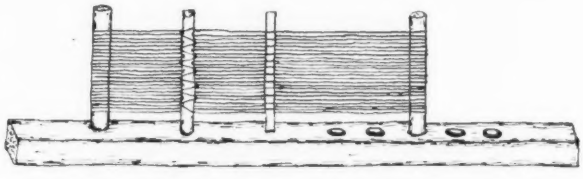

FIGURE 93.—Completed web.

During the demonstration, some time was taken in unraveling tangles and in joining (*tutaki*) the thread, which snapped (*motu*) fairly frequently, and the turns mounted slowly. It did not matter if the turns around the end sticks overlapped or spread unevenly at times, for the regular spacing of the rounds was maintained on the heddle stick by the firm loops made with the netting needle. The depth of the web of warps on the frame set the width of the textile. After four or five hours, the desired depth was reached, in this instance 15 inches (fig. 93), and after adjusting the turns around the end sticks evenly, the web was ready for transference to the loom.

Transferring Warp to Loom

The long beam with the web set up on the sticks is tilted over on its right side so that the near side of the web is uppermost. The cloth and warp sticks are firmly stuck in the holes in the beam. The object of making the large circular holes pass right through the beam is now evident. A short round rod with a diameter less than that of the holes is laid against the bottom of an end stick and a few blows with a wooden mallet free it from the beam. The warp and cloth sticks are released in this way and the heddle and laze sticks are readily pulled out of the beam. The web consists of an under layer and an upper layer with the two sets of odd and even warps, the odd warps being looped to the heddle stick, which lies on the upper layer, and the laze stick, which lies between the sets of odds and evens. The warp and cloth sticks lie between the two main layers. The web with the four sticks is laid clear of the beam, and the next step is to substitute the appropriate pieces of the loom for the four sticks of the beam. These four permanent parts of the loom are the warp beam (*atu*), heddle rod (*niu*), laze rod (*kapi*), and cloth beam (*wakamara*). Note that the name for the cloth beam, *wakamara*, is the same as that for the setting up beam.

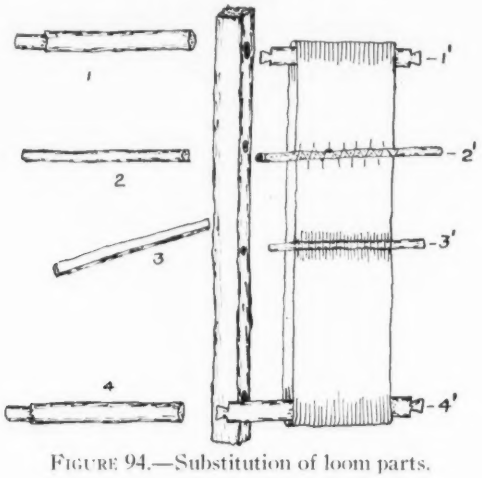

Figure 94.—Substitution of loom parts.

An end of the warp beam (*atu*) is laid against an end of the warp stick; and as the stick is slowly withdrawn from the web, the warp beam, keeping in contact, follows it through to take its place between the layers of the web. Similarly, the heddle rod (*niu*) is placed against the end of the heddle stick and follows it through the loops to take its place above the upper layer. A laze rod (*kapi*) is substituted for the laze stick in a similar way and rests between the odd and even sets of the upper layer. In the last substitution,

the cloth beam (*wakamara*) is simply passed between the two main layers of the web on the inner side of the cloth stick, which is then removed. Thus, the warp beam, cloth beam, heddle rod, and one laze rod take the places of the four sticks used in setting up the web, as shown in figure 94, in which the four discarded sticks (1-4) are shown on the left, the four loom parts (1′-4′) in position on the right, and the dismantled beam in the middle. The next step is to complete the setting up of the loom.

Setting up Loom

The setting up of the loom is done in two stages, the first shown in figure 95. In the men's house, where the weaving was carried on, there was a long wooden bar lashed to two pieces of corkscrew-shaped iron which had been screwed into the floor in line with the open wall of the house (fig. 95, *a*, 1). (The more orthodox arrangement would be to use wooden stakes instead of the iron.) The wooden bar was an inch above the ground level and, as it was a permanent fixture for setting up a loom, was called the *rakau tahimara*. As *tahi* means to hold, the term means "the stick which holds the cloth." Attached to the bar were two stout loops of coir cord (fig. 95, *a*, 2), spaced about 45 inches apart.

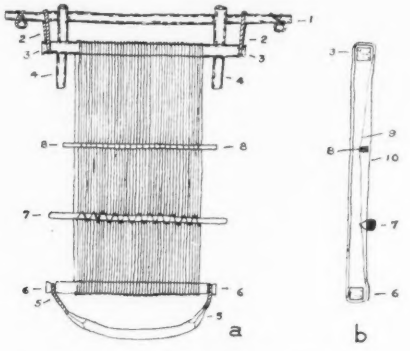

Figure 95.—Setting up loom.

Two men holding the web stretched between the warp beam and the cloth beam carried it to the fixed bar, and the lugs of the warp beam (*atu*) were inserted in the loops on the bar which could be slid along the bar to coincide with the distance between the two lugs of the warp beam (fig. 95, *a*, 3). Two sticks were laid across the bar and their ends placed under the warp beam to raise it off the floor (fig. 95, *a*, 4). The far end of the loom was in position and fixed.

The weaver now sat on the ground behind the cloth beam and, passing the belt (*rapotu*) around the back of his waist, hooked the belt loops (fig. 95, *a*, 5)

over the lugs of the cloth beam (fig. 95, *a*, 6). He leaned back to stretch the web and adjusted his position so as to maintain the tautness of the web between the warp and cloth beams. By leaning forward, he could slacken the warps and thus aid the insertion of the other parts of the loom. As a result of the transference of the web from the beam to the loom, the vertical near side of the web on the beam sticks was now the horizontal upper layer on the loom. The warp beam (*atu*) and the cloth beam (*wakamara*) were in the correct position between the two main layers of the web at the ends, the heddle rod (*niu*) was in position (fig. 95, *a*, 7) with loops around the odd set (*tiroahi*) of warps of the upper layer, and the laze rod (*kapi*) was in position (fig. 95, *a*, 8) between the two sets of odds and evens of the upper layer, the odds being underneath. Their relative position in the side view is shown in figure 95, *b*, in which the *tiroahi*, odd set (*b*, 9), is the lower set and the *toro*, even set (*b*, 10), is the upper set of the upper layer of the web.

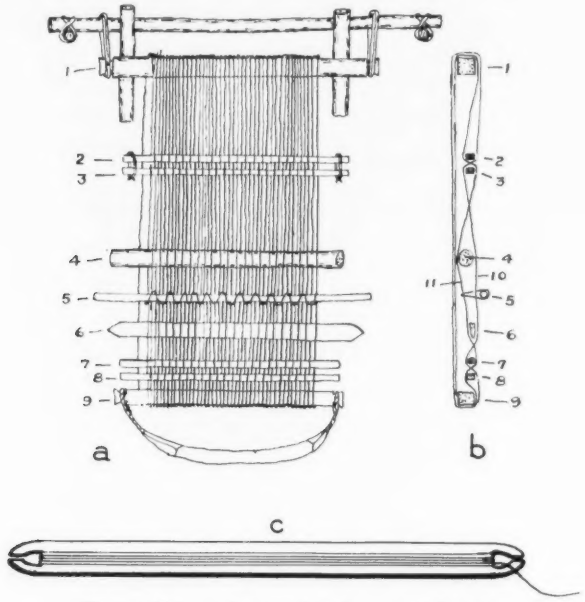

FIGURE 96.—*a*, *b*, complete loom; *c*, shuttle.

The heddle rod was used to lift up the odds and so cross them with the evens, and another piece, called the sword, was also used to further separate the two sets for the insertion of the other parts of the loom. The sword often picked up warps from the wrong set, and corrections had to be made by moving the sword back a little until the misplaced warp was restored to its proper set. Breaks in the thread were frequent, but were quickly joined when the right ends were identified.

The second stage of inserting the remaining parts of the loom is shown in figure 96, *a*, *b*, in which the parts are renumbered as follows:

The warp beam (1), one laze rod (2), the heddle rod (5), and the cloth beam (9) are already in position. A second laze rod (3) is inserted on the heddle side of the one (2) in position. To do this, the heddle rod is slipped forward and lifted to raise the odd set of warps which is below the first laze rod. When the odd set is raised above the even set, the second laze rod (3) is inserted and the odd set thus passed over it. The two laze rods are tied together by their ends which project beyond the edges of the web. By manipulating the heddle rod and the sword, two other laze sticks (7, 8) are inserted between the two sets of the upper layer in front of the cloth beam (9). The important shed stick, or *kaukuru* (4), is inserted between the heddle rod and the far pair of laze rods, the odd set (*tiroahi*) being below. The sword (6) is shown in its functioning position on the near side of the heddle rod. The side view (*b*) shows the position of the loom pieces in relation to the two sets of warps comprising the upper layer in which the even set (10) is above and the odd set (11) below the shed stick.

Figure 96, *c*, shows the shuttle loaded with the continuous weft thread.

Loom

A complete loom (C.10044) with the weaving commenced was presented to the Bishop Museum by Tawhera (fig. 97). This differs from the diagram in figure 96, in that the two near laze sticks (fig. 96, *a*, 7, 8) have moved with the woven part over the cloth beam and advanced along the under layer until (fig. 97) they are approaching the warp beam.

The complete loom consists of nine pieces and a belt, while the shuttle is a necessary adjunct. The dimensions of the various parts were measured on Piripi's loom and these, with the native names and their English equivalents, are given as follows, commencing from the far end:

1. The *atu* (also *kata*) or warp beam is 44.5 inches long and 2 inches square in section. Each end is shaped to a lug (*tauraki*) 1.2 inches long with a constricted neck.

2, 3. Two *kapi* sticks or laze rods are each 33.3 inches long, 0.75 inch wide, and 0.25 inch thick.

4. The *kaukuru* or shed stick is smooth, circular in section, 37 inches long, and 2.3 inches in diameter.

5. The *niu* or heddle rod is 44.5 inches long and 0.6 inch in diameter. It is a round stick of coconut wood, whence it gets its name of *niu*.

6, 7. Two more *kapi* sticks are inserted near the cloth beam.

8. The *papa* or sword is 40 inches long, and 2.8 inches wide. One side edge is 0.5 inch thick and the other is sharp. Both ends are pointed.

9. The *wakamara* or cloth beam is 38 inches long and square in section with even sides of 1.5 inches. Each end has a lug like those of the warp beam.

The *rapotu* or belt on Piripi's loom was of modern style, but the belt with Tawhera's loom was made in the native pattern. It was three pandanus leaves thick and 35 inches long. The ends for 6.25 and 7 inches respectively were folded into the round and each bound with two-ply coir cord in three places. To each end a loop of cord 9 inches and 17 inches respectively was attached.

The loom when not in use is rolled up in a pandanus mat and the parcel tied with a cord. It is usually kept in the loft of a canoe house, particularly that used as a men's house.

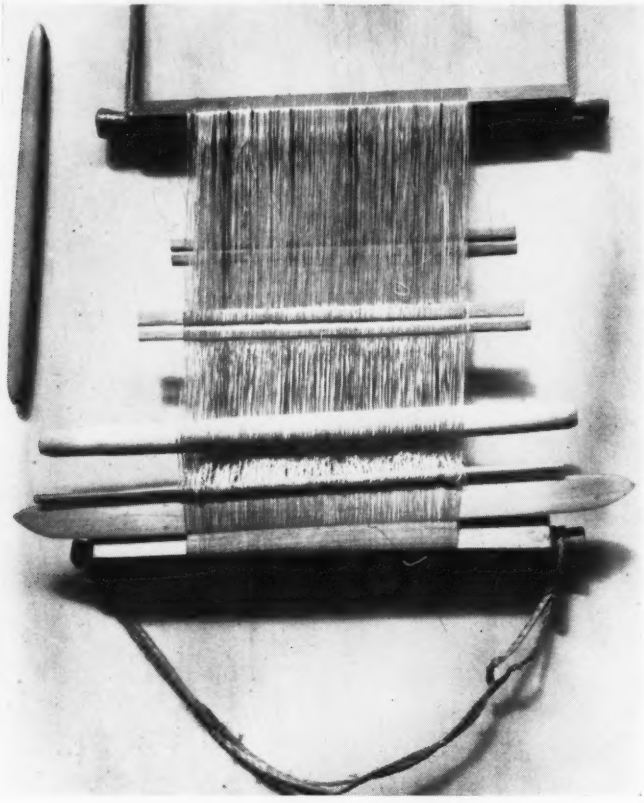

FIGURE 97.—Type loom.

SHUTTLE

The shuttle (*hika*) used by Piripi was a well-made instrument of polished wood, made in the same pattern as the Polynesian netting needles. It was 26.5 inches long, 1.7 inches wide in the middle, and 1.6 inches deep. For a distance of 1.8 inches, the two ends were curved into a blunt point, which was divided by a narrow slit and widened out into a triangular perforation, as shown in figure 96, *c*. In figure 97, the shuttle is shown in side view on the left of the loom.

The loading of the shuttle was demonstrated by Hetata when he made the continuous thread from the hau bast. The bast thread used to form the warps

was also used as the weft material in the shuttle. Holding the shuttle by its middle with the left hand, Hetata fed the thread in at the split ends with the right hand. He reversed the shuttle alternately to bring the ends closer to him in order to place the thread accurately through the end splits. In this way, the thread was wound longitudinally around the thin middle part of the shuttle until the turns filled up to the level of the raised side edges. The thread was run out from the round basket holding the coils of thread and termed the *kata hanga*.

Weaving Process

The whole web of warps on the loom is termed *ti hanga*, a single warp thread, *konchanga*. The *konchanga* threads, however, are more specifically divided into *tiroahi* (odds) and *toro* (evens). The weft thread is termed the *konchika*.

The process of weaving is carried out with the evenly divided odds and evens of the upper layer, the lower or under layer merely sliding along toward the warp beam until it rounds it to appear as the upper layer.

The function of the shed stick with its wide diameter is to increase the depth of the space between the sets of odd and even warps of the upper layer. The sword, which is even wider than the shed stick, is used to further increase the depth of the space in order that the shuttle carrying the weft thread may be passed readily between the two sets. The sword is passed between the two sets on the near side of the heddle rod with its loops. The shuttle is passed through in the space between the sword and the near laze rods at the commencement and between the sword and the edge of the weaving as weaving progresses. When the odd set is below, as in figure 98, *b*, the space is termed the counter shed; and when the odd set is pulled up above the even set by the heddle rod, the space is termed the shed. The process of weaving in the alternate formation of sheds and counter sheds is illustrated by figure 98, *a-e*, and described below.

a is the position after the loom parts have been placed in position, as in figure 96, *b*, with the shed stick (1) and the heddle rod (2) on the left and the near laze sticks (3) on the right. The odd set (4) is below the even set (5), and the space between them on the right of the heddle rod is a counter shed.

In *b*, the weaver picks up the sword and passes it through the counter shed on the near (right) side of the heddle loop; never on the flat, as it might pick up warps from either set, but at a slant so that the point of the sword is clear of both sets. When the far end is through on the left, the sword is turned on the flat with the sharp edge toward the weaver. With both hands on the ends of the sword, he brings it back to the near laze rods (3) to clear the space between the two sets. He slides the sword back toward the heddle rod and turns it vertically with the back upward (6) to make the counter shed deeper for the passage of the shuttle. He leans back on the belt so that the tautness of the web keeps the sword in the vertical position.

Picking up the shuttle, the weaver unlooses a couple of lengths of the weft so that there will be enough slack to cross the counter shed. He passes it into the counter shed from the right and shoots it across with the right hand. As it emerges on the left, he catches it deftly with the left hand, reverses it, and lays it on his lap. Holding the end of the weft on the right, he seizes the end emerging from the counter shed, tautens it by pulling with the left hand, and lays it (7) in the angle formed by the crossing of the two sets in front of the near laze sticks. He flicks the sword with his right hand and it falls flat, then removes it with the right hand and holds it.

In *c*, he parts the loops on the heddle stick in the middle to allow his left hand to grasp the wood. He raises the rod to pull the lower odd set (4) up above the even set (5) and so create a shed with the odd warps above. [The act of lifting the heddle rod is termed *tahiaka*, as in the phrase *tahiaka ti tiroahi* (lift the odd warps).] Holding the sword by the middle of the back with the right hand, he pushes down the even set in front of the heddle loops and the shed stick farther forward.

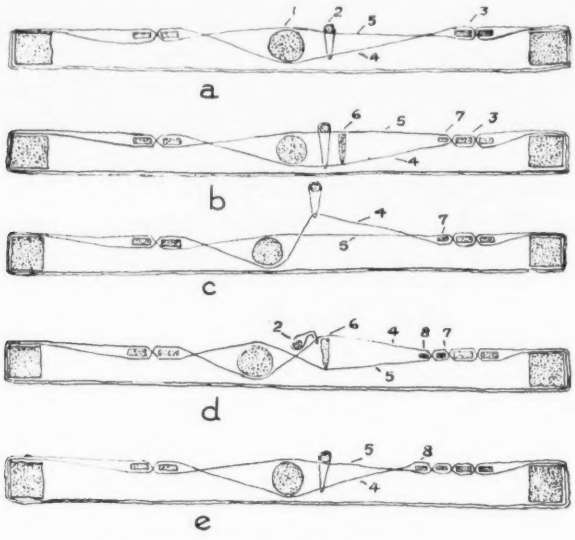

FIGURE 98.—*a-e*, sheds and counter sheds.

In *d*, he passes the sword through the shed on the slant and then flattens it with the edge toward him. Holding the two ends, he brings it back toward the near laze rods and thus brings the crossing of the two sets hard up against the first weft course or pick (7) laid in the preceding counter shed. Extra strokes with the sword are used to beat the weft back to ensure close weaving. The sword (6) is slid forward toward the heddle rod and turned vertically on edge to increase the depth of the shed, and the heddle stick (2) is let go.

The weaver picks up the shuttle from his lap with the left hand and, if there is not enough slack left, frees a couple of turns from the shuttle. He shoots the shuttle through the shed with his left hand and catches it with the right as it emerges on the right. He gives it a flourish to reverse the ends and lays it on his lap. The sword is flicked flat and removed. A second weft pick (8) has been added to the weaving.

As shown in *e*, on the removal of the sword, the weight of the shed stick drags the odd set (4) down below the level of the even set (5), as in the original position (*a*). This movement also crosses the two sets in front of the second weft pick (8).

The weaving process is a repetition of the movements shown in figure 98. The heddle rod pulls up the odd set to form a shed and the shed stick weighs it down to form a counter shed. The process continues in this manner with the sword assisting in increasing the depth of the sheds and counter sheds for the easy passage of the shuttle. The sword also beats the successive weft courses, or picks, close to the preceding picks to make the weaving close and even. As the weaving commences with a counter shed, the shuttle is naturally shot through from the right and, as the weft is a continuous thread, is returned from the left in the succeeding shed. These first two movements establish the routine of the shuttle entering from the right through the counter sheds and from the left through the sheds.

Tawhera, who demonstrated the process of weaving and its details, was careful to explain that after the shuttle passed through, the slack on the entering side was hooked up on the forefinger of that side and the edge of the weaving held by the thumb and middle finger. The slack was then pulled taut from the other side as the forefinger let go, but the side edge was held to prevent the pull on the weft from dragging the marginal warps out of line.

As the weaving moved forward, Tawhera grasped the ends of the cloth beam and twisted them toward himself, at the same time leaning back on the belt to keep the web fairly taut. As the cloth beam was square in section, the edges were able to grip the cloth and move it backward over the upper surface of the beam. By this means, the weaving edge was maintained at the right distance from the weaver. The two near laze rods with the commencement of the cloth worked back over the cloth beam and entered into the under layer below. As the weaving made progress, the two laze rods heading the completed cloth moved forward and, rounding the warp beam, appeared on the far end of the upper layer.

Tawhera was very particular in showing me how to deal with a snapped warp, as these breakages were fairly frequent and the mending an essential part of the technique. First the broken ends had to be traced to see if the warp was a *tiroahi* (odd) or a *toro* (even). The far end was readily identified, as the *tiroahi* pass over the near one of the far pair of laze rods and the *toro* pass under it. The near end was identified as to whether or not it passed through a heddle loop, and if the end was farther back near the weaving edge, the warp beside it was identified. In joining, it was impossible to draw the ends together to tie them, so a fresh piece of thread was tied to the far end and brought back to the weaving edge, where it was either tied to the near broken end or simply overlaid past the weaving edge and the near broken part pinched off at the weaving edge. If the far end of the broken warp had retreated beyond the far pair of laze rods, care was taken to thread the joined thread in the correct position over the two laze rods. Similarly, the new

thread had to be threaded through the correct heddle loop if it was a *tiroahi*. When the weaving moved forward, the ends of the overlapped new threads were left as loose ends on the surface of the weaving. The frequency of breakage was seen in the number of loose ends (*keinga*) dotted about over the surface of the weaving. In the later joins, the near ends of fresh warp additions could be tied to a convenient *keinga* on the same line as the broken warp. The weavers, who were expert at mending, used the local weaver's knot shown in figure 89 for this purpose. They used the right hand to part the warps while the left hand was passed in from the left between the two main layers to locate and mend the breaks.

Changes in Loom Parts

When the original near laze rods with the commencement edge of the weaving appear over the warp beam on the upper surface and begin moving toward the weaver, the decreasing stretch of unwoven material necessitates changes in the loom parts. First, the two laze rods on the far side of the shed stick are removed. With the shortening stretch, the sheds and counter sheds become smaller and the larger shed stick, sword, and shuttle are changed for smaller ones.

Provision is made for the changes by having extra sets of smaller size. Thus, in a complete set of loom parts, there are four shed sticks (*kaukuru*), three swords (*papa*), and two shuttles (*hika*). In Tawhera's sets the measurements in inches are as follows:

Shed sticks	Length	Mid Diameter	End Diameter
No. 1	40	2.6	2.2
No. 2	34	2.1	1.7
No. 3	38.5	1.6	1.5
No. 4	?	1.1	1.1

Sword	Length	Width	Back Thickness
No. 1	42	2.8	0.4
No. 2	41	2.3	0.3
No. 3	43	1.9	0.3

Shuttle	Length	Width	Depth
No. 1	29	1.7	1.7
No. 2	21	0.9	0.9

In these parts, the length does not matter much, but the thickness is important, owing to the narrowing depth of the shed and counter shed. The changes do not affect the warp and cloth beams and the heddle rod.

As the weaving closes in, the change in parts are as follows, the numbers corresponding to those in the preceding list:

	Shed Stick	Sword	Shuttle
Original	1	1	1
First change	2	2	1
Second change	3	2	2
Last change	4	3	2

In changing the shed stick, the end of the substitute is placed against the right end of the shed stick in occupation; and as one is withdrawn toward the left, the other follows it up until it is in position. As the ends of the weaving get nearer, the shed stick (4) is removed altogether. When the unwoven part of the web is about 9 inches wide, the remaining pair of laze rods is removed and the heddle stick with its loops pushed over against the far edge of the woven cloth.

Cutting Cloth

In the demonstration, the weaving process was completed with nine inches of unwoven web (fig. 99, *a*). The sword was inserted between the two layers of the cloth, not the two sets of the upper layer. It was turned on edge with the thick back uppermost to correspond with the middle of the unwoven warps. The middle position was checked by stretching a piece of thread across the space and doubling it to measure where the sword should be. By leaning back on the cloth beam, the tension kept the sword on edge in position. The warps were cut on the back of the sword on the left, the middle, and the right, but in all positions some warps were left uncut to keep up the tension. The three small groups were then cut and the severance completed.

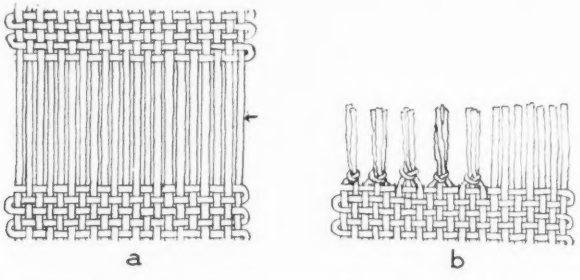

Figure 99.—*a*, completed cloth, arrow shows cutting point of unwoven web; *b*, fixation of fringe.

The heddle stick was grasped along its length between two swords and was drawn back so that its loops cleared the cut ends of the warps on the far side. The string used to form the heddle loop in this particular garment measured 23 *roho*, or arm spans. As Tawhera's arm span proved to be exactly 6 feet, the length of cord used to form the heddle loops was 138 feet. This

particular garment, which was not that described in setting up the web, was 29 inches wide, 8 feet 3 inches long, and with fringe 4.5 inches long at each end.

The cloth was spread out, and the straggling ends from broken warps (*keinga*) cut off. The statement, "Taku mara ku tu nia keinga" (My *mara* is having the *keinga* cut off) was an idiomatic announcement that the cloth was completed.

Fixing Fringe

The last process consists of knotting the free warp ends which form the fringe to prevent the cloth from unraveling at the ends. The fringe threads are knotted in groups of two or three by looping one around the others and tying it in an overhand knot. After the end of the tying thread is passed through its loop, the loop is drawn taut and held down close to the woven edge by the left thumb, and the right hand pulls the end to remove the slack. The knot is smoothed down with the fingers and the end of the knotting thread joins the others in the fringe (fig. 99, *b*). The weaver usually ties a few at each edge and in the middle and completes the others when he has leisure.

The Cloth

The finished cloth is white or light brown in color. The loom and the weaving are of the simplest form, for no dyes are used and the weaving is in plain check. Compared with plaited material, the cloth is very fine, but compared with the products of European and American looms, it is coarse. The textile is termed *mara hau* and was formerly the correct material for women's skirts, which were termed *teru* (*seru*). It was manufactured by men for their wives and sweethearts and evidently not for their own wear.

TOOLS

SHELL ADZES

The adzes (*toki*) on an atoll are of necessity made of marine shell, generally Tridacna (*pahua*). Kapingamarangi informants held that the adzes were generally made of *tukima*, another large shell; but an old man who had made the statement concerning the *tukima*, had to admit that the 29 specimens we had collected were all Tridacna shell. Identification is easy, as the marking on the outer surface of the two shells is different, that of the Tridacna consisting of close parallel curves which cross the hollows and ridges in the shell.

As shell adzes have been out of use for a considerable time, it was reasonable to expect that any shell adzes picked up were old specimens that had been made for use in the period preceding the acquisition of steel tools. However, the present generation continues to make shell adzes and to haft them as curios to give away to visitors or to sell to collectors. Of the 29 specimens of perfect and broken adzes, many are clean and white and bear evident traces of having been recently worked on a grindstone. However, it may be assumed that they follow the pattern of older adzes, which are picked up now and then.

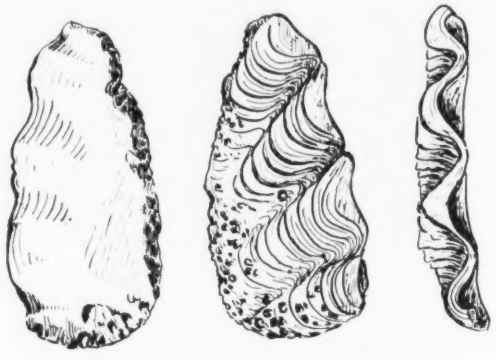

FIGURE 100.—Rough shell adz.

Five of the specimens, old in appearance, roughly shaped, and without a cutting edge, are evidently in the preliminary stage of shaping. A typical one (C.10058) is 132 mm. in length and 63 mm. in its greatest width, which is above the curved-in side edges toward the lower edge. The outer surface is crossed obliquely by four ridges with fairly deep hollows between. The thickness of the shell in the hollows is 10 mm. and on the ridges, 14 mm. (fig. 100).

The completed adzes may be classed as two distinct types with different uses.

TYPE 1

The common, thin-bladed adzes are made of a part of the shell which does not include the thick hinge. They have a narrow rounded poll and a wide cutting edge and give the appearance of an equilateral triangle with the base at the cutting edge. The front surface is formed by the inner, shiny part of the shell, and it is thus concave longitudinally and to a lesser extent transversely. The lower border, because of its forward projection, is sometimes ground so that the plane of the surface is level with that of the blade. The back of the adz is formed by the rough outer surface of the shell with ridges and hollows inclined obliquely downward and crossed by the close

parallel grooves, which are curved or wavy in the way characteristic of Tridacna shells. Usually there are two or three oblique ridges, with the lower one or two ground down to make a more even surface although the hollows still persist. The lower border is ground to a bevel to meet the front surface and so form the cutting edge which is usually straight with a slight upward curve at each end. The side view shows the ridges and hollows of the back surface. The narrow poll is rounded off.

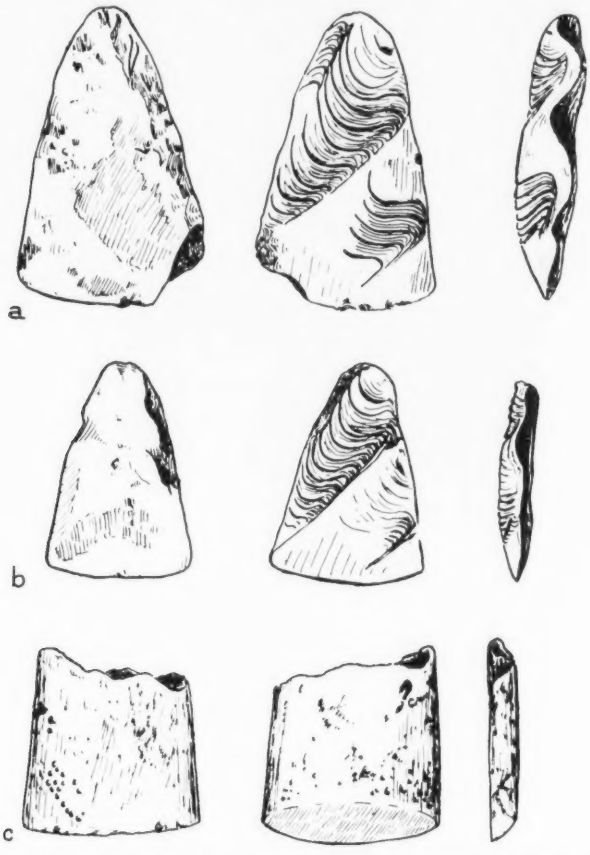

FIGURE 101.—Common shell adzes, type 1: *a*, good average type; *b*, slightly smaller; *c*, lower portion of probable variation.

The specimen (C.10056) shown in figure 101, *a* is a good average type, but the left corner of the cutting edge is broken off. Its length is 118 mm. and the width at the cutting edge is approximately 70 mm. The general thickness of the blade is 15 mm., and the thickest part over the ridges is 18 mm. The lower edge in front is ground to level the surface, and the back is ground to a bevel to form a straight cutting edge. The ridges on the back

are ground down slightly to level the surface, but a marked oblique hollow persists. The sides are neatly ground and rounded off from the back.

A second form (C.10048) is smaller, but conforms in treatment to the preceding adz. Its length is 81 mm., the width at the cutting edge 56 mm. The greatest thickness of the blade is 13 mm. The ridge on the back surface is well grooved down (fig. 101, *b*).

There was probably a variation of type 1 with a wider poll and with the sides of the blade more nearly parallel. No perfect specimen was collected, but the lower part of such a variety (C.10068) is shown in figure 101, *c*. In this specimen, the front of the adz was formed by the inner surface of the shell. The back is well ground down and shows no ridges or hollows. The cutting edge bevel on the back shows a distinct edge where it meets the back surface.

Type 2

Hollowing-out adzes (termed *toki hoto waka*, adz for hollowing out canoes), were made of thick Tridacna shell obtained from the thicker hinge part of the shell. They show no signs of ridges or hollows so characteristic of type 1. One perfect specimen was obtained and four broken or unfinished specimens. These were readily recognized by informants and given the name and use stated above.

The perfect specimen (C.10031) is 88 mm. long and 47 mm. wide at the cutting edge, with a greatest thickness of 27 mm. The front surface is markedly convex longitudinally and transversely. The butt end narrows to a rounded poll, and the lower edge of the blade is convex to form a curved cutting edge. The back is concave longitudinally and flat transversely to where it meets the cutting edge bevel, which forms an elliptical surface. The sides are rounded off at the front and back edges. The whole is ground smooth (fig. 102, *a*).

A broken specimen of a large adz (C.10077) consists of the lower half of the blade with the cutting edge and cutting edge bevel intact. The broken length is 87 mm., the full width, 53 mm. The thickness is 27 mm., but the upper part of the adz must have been thicker. Like the whole specimen, the front part is convex longitudinally and transversely and well-ground. The back has the remains of a groove from the inner surface of the shell which was not entirely ground out. The bevel surface is flat, but the upper part is indeterminate through the fracture. The cutting edge is markedly convex (fig. 102, *b*).

The other three specimens are fragments, but the thickness of the shell and the convexities of the smooth front surface are sufficient to show that they belong to type 2. They were recognized by native informants as being *toki hoto waka*.

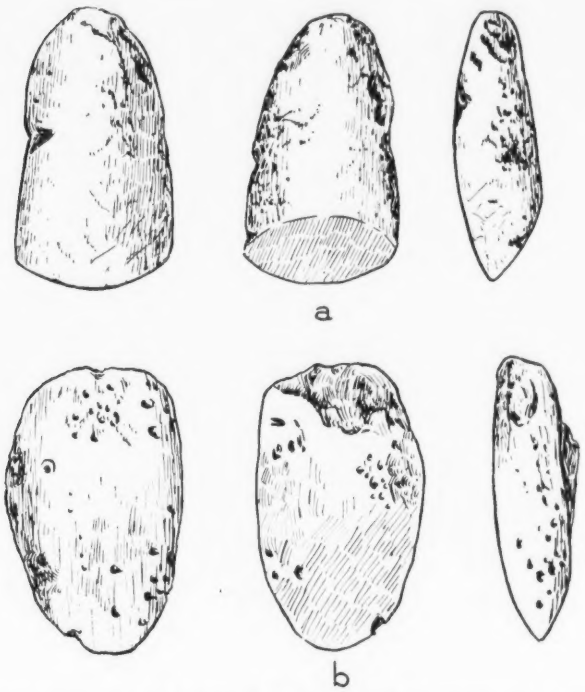

FIGURE 102.—Shell hollowing-out adzes, type 2: *a*, perfect specimen; *b*, broken specimen.

HAFTED ADZES

A number of hafted adzes were contributed to the Bishop Museum collection, and though the shell adz heads had been trimmed up on a grindstone, it may be assumed that the form of the haft and the lashings follow a technique which had been handed on in oral descriptions.

The handles (*kau*) are formed of a branch of hau which is naturally attached to a portion of a larger branch or trunk. The length of the smaller branch which forms the shaft ranges from 12 to 16 inches and the thickness is less than 1 inch. The shaft forms an angle with the part of the haft which forms what has been termed the foot. The upper part of the foot projects above the junction with the shaft at an obtuse angle for about 2.5 inches, and it is trimmed to a median point, this upper part forming the heel. The lower part of the foot projects downward from the shaft junction at an angle less than a right angle for a distance of 2.5 to 3.5 inches, and this lower projection is termed the toe. The front of the foot forms a vertical surface from heel to toe, but the lower part of the toe is cut to a lower plane to fit the upper part of the shell adz. The upper edge of the recess forms a shoulder, and is shaped to fit the rounded poll of the shell adz.

Owing to the length of the toe, the socket for the butt end of the adz is entirely on the toe and, with the adz in position, is lashed securely with close transverse turns passing around the adz butt and the toe of the haft.

A small adz (C.10026) illustrates a simple lashing with close transverse turns. The shaft is 12.75 inches long and is 0.75 inch thick. The foot is 5.2 inches in length, of which 2.6 inches are formed by the toe. The front surface of the foot widens out gradually from the pointed heel to 1.6 inches in width at the lower end of the toe. A socket 1.7 inches long is cut out at the lower end of the toe for the adz butt, and this socket is flanged at the sides. The commencement end of a left-hand cord is covered at the back of the toe by 12 close ascending transverse turns, and the finishing end is passed under the two last transverse turns, which are drawn taut, the slack pulled out, and the end cut off. The lower end of the adz blade with the cutting edge projects for one inch below the toe (fig. 103, *a*).

A larger adz (C.10027) is lashed to the haft with two sets of transverse turns. The shaft is 14.5 inches long and 0.8 inch thick. The foot is 7.1 inches in length, of which 2.8 inches form the toe. The front surface of the foot gradually widens to 2 inches at the lower end. The lower part of the toe is cut down for 2.5 inches to form the socket, the lower part being cut completely across the surface and the upper part curved convexly to fit the upper end of the adz. The lower lashing consists of four close turns with the end of the cord (left-hand) passing under all four turns and then tied to it tightly with an overhand knot. The upper lashing consists of nine close transverse turns which cover the upper end of the adz. The lower end of the adz with its cutting edge projects for one inch below the end of the toe (fig. 103, *b*).

The hollowing-out adz (C.10031) is more elaborately lashed than the preceding two. The shaft is 15.75 inches long and 0.9 inch thick. The foot is 5.2 inches long of which the toe is 3.1 inches. The front surface of the toe has an even width of 1.5 inches, and the lower part is cut down to form a socket for the adz, the length from the lower border to the upper curved border being 2.75 inches high. The composite lashing consists of a lower series of five close transverse turns which are seized with five and six close turns on each side of the toe. Three turns ascend from one side of the lower lashing to cross obliquely over the upper part of the adz butt, pass around the back of the toe and descend obliquely over the front to form a lozenge pattern on the front of the adz. The ascending three turns on one side and the descending three turns on the other side are seized on each side of the toe in a manner similar to the seizing of the five lower transverse turns. (The lashing cord is a right-hand twist.) The back of the toe is grooved near its lower end to accommodate the lower turns of the lashing. The part of the adz blade which projects below the toe is formed by the bevel of the cutting edge which is 1.2 inches high in the middle line (fig. 103, *c*).

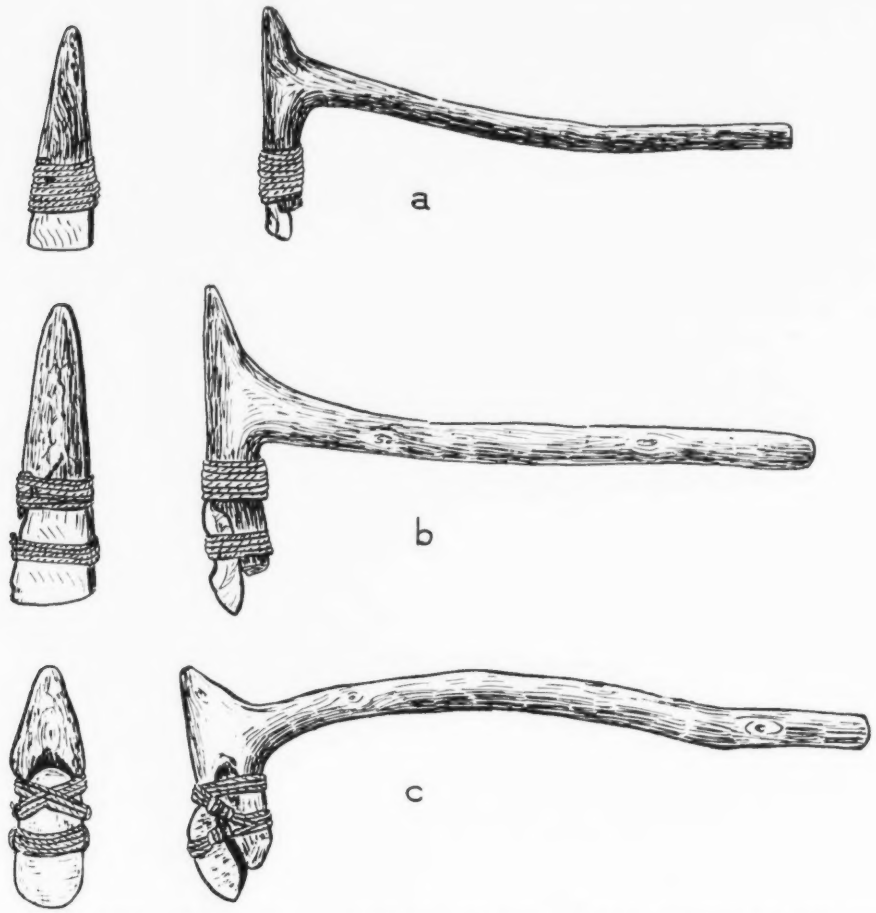

FIGURE 103.—Hafted adzes: *a*, small adz with simple lashing; *b*, larger adz with two sets of lashing turns; *c*, hollowing-out adz with more elaborate lashing than *a* and *b*.

The adzes figured are small, but the general principle of hafting and lashing must have been similar for the larger adzes. A feature of the lashed adzes is the short length of blade which projects below the toe, a technique which probably lessens the danger of the shell adz breaking. The shell takes a sharp edge and in the experiment of cutting down a hau sapling, the hafted shell adz cut easily into the green hau wood. With larger adzes and more labor than is called for with metal tools, one can quite understand how large trees were felled and shaped into canoe hulls. The adzes of type 1 were evidently used for felling the trees and cutting out the notches in shaping the trunk. The adzes of type 2 were then used for hollowing out the hull. Adzes of type 2 could also be used for hollowing out the interiors of wooden bowls.

CHISELS

One shell chisel (C.10116) was obtained on the atoll. It is 2.75 inches long, 0.75 inch wide at its widest part near the cutting edge, and 0.5 inch thick. The upper end curves to a blunt point, and the lower end has a convex cutting edge formed by a well-ground bevel surface on the back. The back has a natural longitudinal groove. One side has a series of natural grooves that are evidently formed by the dentition of the outer lip or of the columella of a marine shell, which Wray Harris of the Bishop Museum staff thinks is *Cassis cornuta* (fig. 104). No information was obtained as to how such instruments were used.

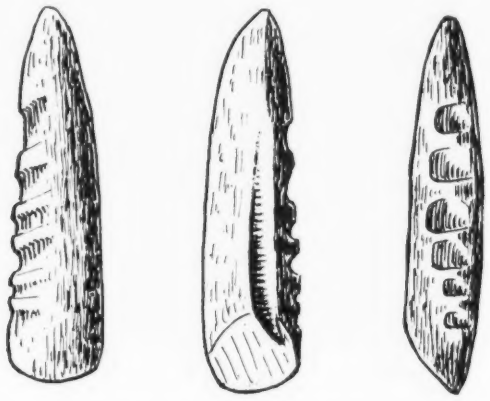

FIGURE 104.—Shell chisel.

PUMP DRILL

The pump drill (*ti hou*) is still in use, but the point is now formed of metal. However, a specimen made for Bishop Museum by a craftsman at Werua was provided with a shell point to comply with native tradition. The instrument is composed of a vertical shaft, a wooden balance disk, a handle with two cords attached to the shaft, and a point lashed to the lower end of the shaft (fig. 105). The shaft (*pou*) of the Museum specimen (C.10011) is 30 inches long and 0.9 inch thick in the upper 18.75 inches of its length. A shoulder is formed by increasing the thickness to 1 inch from which it tapers to a thickness of 0.6 inch at the lower end. A wooden disk (*tuatika hou*), 6 inches in diameter, 0.8 inch thick in the center and 0.4 inch thick at the edges, is perforated with a central hole 0.9 inch in diameter.

The disk is slipped down over the top of the shaft and stopped by the shoulder 18.75 inches from the top. A cross bar which serves as a handle (*kau*) is formed of a straight stick of hau, 18.5 inches long and 0.7 inch thick. The handle is attached to the shaft by a long two-ply, left-hand cord

which is tied by its middle to the top end of the shaft with a clove hitch. Each limb of the cord is tied to the outer ends of the handle with a clove hitch supplemented by an overhand knot. The handle ties are 2.5 inches in from the ends of the handle, each cord being 17 inches long from the top of the shaft to the handle, and the distance between the two ties on the handle is 13 inches. The point (*mata*) is formed of a thick piece of serrated shell, 1.5 inches long, of which 0.6 inch of the upper part is let into a groove cut vertically in the lower end of the shaft. The lashing of the point to the shaft is somewhat intricate. The lashing cord, which is finer than the handle cords, is tied at its middle to the lower end of the shaft with an overhand

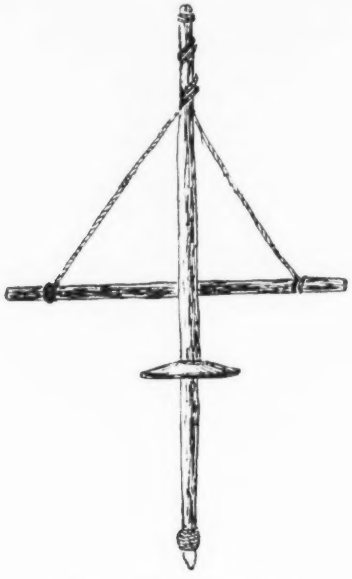

FIGURE 105.—Pump drill.

knot made on each side of the shaft so as to work with two strings. Each string makes an alternate turn and an overhand knot on its own side. After proceeding with close turns upward for an inch, the lashings turn downward over the first layer. Each string makes an alternate turn and forms a circular hitch with each turn so that the line of hitches descends vertically on each side to the commencement end of the first layer when each string is fixed with an overhand knot to its own bight. This form of seizing with two rows of hitches seems to be unique. The technique of the circular hitch is shown in figure 83, *c*.

The method of using the drill was demonstrated by Alfred Patterson. He placed the point of the drill on the part of the object to be drilled and rotated

the shaft to wind the handle cords around it. With the cords slack, the handle bar was 1.5 inches above the disk; and when the cords were wound, the handle bar was raised 6 inches or so. The cross bar was held by both hands on the ends outside of the cord attachments. Downward pressure on the handle bar caused the cords to unwind and rotate the shaft and the point at its lower end. The knack in using the drill is to apply sufficient pressure to cause the shaft to overspin and thus rewind the cords in the opposite direction. With practice, the alternate spinning of the shaft is made continuous without a break and thus bores the hole. Formerly, owing to the thickness of the shell point, the hole was funnel shaped; and in some materials, the hole was bored from each side to meet in the middle and thus avoid an unsightly large opening. Some of the drills made for boring holes through shell for fishhooks must have been much smaller than the drills described. In Alfred Patterson's drill, the handle was attached to the shaft by six strands of two-ply cord.

The pump drill is an improvement on the cord drill used in New Zealand in which there was no cross bar attached to the two cords tied to the top of the shaft. The cords were wound up by rotating the shaft and the ends of the cords pulled to cause it to rotate. It is a matter of speculation whether the addition of the cross bar in some parts of Polynesia was a late development in European times or an original invention.

CANOES

INTRODUCTION

Every family has one or more canoes, for they are used as transport to the various islands of the atoll to work in the cultivations and bring back food and other supplies. And they are a necessity in fishing within the lagoon with nets, traps, and lines, and for deep sea fishing beyond the reef. The people take great care of their canoes. They are lodged in canoe houses for protection from the sun and rain (fig. 29) and on landing on the outer islands, the hulls are covered with coconut leaves or with the sail. All canoes carry a sail when visiting the outer islands or being used for fishing, for use when the wind is suitable. Otherwise the paddle is employed, or, for skirting along the islands in shallow water, the pole is used.

The true Kapingamarangi canoe has five parts with the dugout hull furnished with a washstrake on each side and the head and stern finished off by the addition of an end piece. It is also a single outrigger canoe with the outrigger on the weather, or left, side. Only two of these canoes with the outriggers fitted to the hulls were in condition at the time of our visit in 1947, but several hulls were stored in the lofts of various canoe houses. They were readily identified by a small curved projection on the upward slope from the keel at the bow and stern and also by the more open upper edges of the hull

as contrasted with the tumble-home hulls of the Nukuoro type of canoe, which is now in general use.

The Nukuoro canoe, which has been generally adopted, was introduced by Alfred Patterson, who was an expert builder and who had spent some time in residence at Nukuoro. On his return to his home in Kapingamarangi, he built a canoe of the Nukuoro type for his own use. The canoe caught the popular fancy, and Patterson was kept busy filling orders for the local people. As the local craftsmen mastered the technique, they began to build the Nukuoro type of canoe in preference to their own, hence it completely superseded the local canoe. The reason given for the change is that the Nukuoro type is much easier to make and has fewer parts in both the hull and the outrigger apparatus. The hull has no washstrake and gunwale rail, the outrigger has two main booms instead of three, and the curved booms are absent. There is also a saving of material, which is important with the limited timber supply of an atoll.

Both the Kapingamarangi and the Nukuoro types of canoe have been described by Eilers (*2*) and Hornell (*7*). However, as the Bishop Museum expedition was able to obtain more detailed information and to record the correct native names of the various parts, I shall redescribe them. The two distinct types will be dealt with separately, but as the preliminary stage is common to both types, it is described first.

SHAPING HULL

We were fortunate in being invited to witness the preliminary shaping of a canoe hull on the island of Ringutoru. The canoe was to be built for a young man, whose family attended in a body to supply and prepare food for the working party. The labor was purely voluntary, and workers came from both Touhou and Werua.

When we landed on the beach at Ringutoru, three pigs were being singed with dry coconut leaves and cleaned and washed in the lagoon. The smoke of fires rose where women near the cooking house were busy preparing the food, some for a midday snack, but the pork and special preparations were for the main meal or feast when the day's work was over. The sound of chopping led us to the site of operations in the interior.

A large breadfruit tree, paced at about 90 feet long, had been felled, and the party of workers armed with steel axes was gathered along its length. The log for the hull, which was partly severed, was 23 feet 4 inches long. This was to provide a canoe 3.5 *roho* (arm spans), roughly about 21 feet, long. The pastor of Werua was busy severing and trimming the butt end of the log, and Ti Rongorongo was engaged in completing the severance of the far end. Ti Rongorongo as the expert director of operations (*taki ti mo me*) wore a

pandanus mat strapped around his waist, evidently to distinguish him from the other workers. (See figure 4.) Our informant explained that while there were many expert canoe builders on the job, they remained silent as regards what was to be done and took their directions from Ti Rongorongo, who had been chosen for the particular task of rough shaping the hull. Hakaripi, equally if not more expert, had been selected for finishing the hull and adding the outrigger parts when it was taken to Werua for completion of the canoe. Thus, Hakaripi was present in a subsidiary position and took orders from Ti Rongorongo. Later Ti Rongorongo would serve as cheerfully under Hakaripi.

The first organized attack on the log was on the upper part to shape out the lateral slopes to the keel (*iwi*), which would be uppermost in the first stage of the work. Six men with steel axes mounted the log and proceeded to cut scarfs, or notches, about 7 inches apart on one side of the upper slope of the log. This process is termed *tutanga* (*tu*, to cut; *tanga*, piece or section); and the sections between the vertical cuts are also termed *tutanga* (fig. 106, *a*). When the cuts were deep enough, other workers proceeded to chop out (*tiha*) the *tutanga* pieces. This action is referred to as *tiha nia tutanga*. The other side of the log was treated similarly, and the upper part of it was converted into two sloping planes converging toward the apex which was to form the keel. As the first set of *tutanga* had not removed enough wood from each side, a second series, of shallower grooves, was cut and the sections chopped out with lateral blows of the axes. In the deeper process, the axes cut through the lighter-colored sapwood (*kono te*) into the red heartwood (*me me*). The part of the trimmed log formed by the deeper cuts is termed *pa* and the sections of wood cut out are distinguished from the first set by the term *tutanga pa*.

Only about six men at a time could work on the trimming down of the *pa*, even fewer when the sections were cut out. The men usually stood on top of the log and swung their axes sideways in cutting out the sections between the notches, at the same time smoothing out any knobs. They often overswung when the axes glanced off the surface, hence they took care not to stand too close to their neighbors. At first I feared that accidents would occur through occasional wild swings, but the workers never let go their axes and their judgment of spacing was sound. As there were 16 men on the job, they could not all work at once, so those not engaged sat about gossiping and smoking cigarettes. Every now and then, one of them rose to his feet and relieved a worker on the log without any orders from the expert in command. Thus, no worker became exhausted and the work went forward easily at the best possible speed. Probably an American overseer would have wanted to strike some of the men off the payroll, but the payroll and its attendant demands have not yet reached Kapingamarangi.

Ti Rongorongo gave an occasional glance along the sides to see if they were even and symmetrical and issued a word of advice as to the removal of

more wood. The *pa* having been completed to his satisfaction, he called up all his forces to turn (*huri*) the log (fig. 106, *b*). The 16 men of the working party, or all who could get a handhold on the log, lined up on one side and joined in an oldtime turning chorus of which the words are: Koia ra ka ha—ep.

FIGURE 106.—Shaping hull: *a*, *tutanga* notches; *b*, turning the hull.

On the concluding ejaculation *ep*, all pushed together and held the ground gained while they drew breath for a repetition of the chorus. It took three *eps* to turn the log over into the required position on its keel, and there it was chocked with pieces of timber. I tried the chant out, but purposely ended on the word "up." I was immediately corrected and told that *ep* was the right word, so it is probably a local invention and not a corruption of up.

After notches had been cut to form *tutanga* along the top of the log and then were cut away and the level lowered, the upper, gunwale part of the hull began to appear. The upper sides were also trimmed down in the same way to form planes which met the upward sloping planes from the keel at an obtuse angle, for the canoe was to be of the Nukuoro type with a tumble-home hull. In a Kapingamarangi hull, this extra trimming would have been omitted. At the same time, men were narrowing the ends to form the bow and the stern, with the bow, as always, at the butt end of the log. Two branches at the stern end were removed and the parts trimmed to the lines of the hull.

When the upper horizontal plane was made fairly level by means of axes, Ti Rongorongo suddenly mounted the deck with a steel adz blade lashed to a short handle with a coir cord, and started to smooth off the middle part of the surface. As if this were a signal, five men armed with similar adzes mounted the log, spread along its length, and proceeded with exact short strokes to level the sections each occupied. The process of trimming with adzes is termed *hara*.

The sides were also evened along the upper edges, at which stage, Ti Rongorongo vacated the deck and took up a position at the stern end of the log. Glancing along the lines of the hull, he issued a few words of instruction to various workers to take off a little (*turi*) here or some there. The person addressed by name laid his adz against the spot and asked "hinei" (here)? Upon receiving the answer "uwe" (yes) he quickly removed the surplus part which had caught the eye of the expert director.

The next process was termed *hakatere tara waka* which means marking out the side lines or boundaries for excavating the hold. Though not a measuring rule or a pencil had been laid on the log to this point, one would have expected the marking out of exact lines to demand the personal attention of the expert in charge and to be marked out in charcoal as a guide to those who would hollow out the interior. The guiding lines were made, but in a totally unexpected manner. Two workers, one on each side of the hull, commenced at the stern end and proceeded to mark out the lines for the inner sides of the gunwale on the side opposite to themselves with short, sure blows of their adzes. They worked down the whole length of the hull and the lines were cut on each side of the upper surface without any hesitation. Ti Rongorongo looked on without a word and his apparent confidence in the results was fully justified. To me, it was a remarkable example of perfect coordination of eye and hand.

The lines were no sooner marked out than three men with axes began to cut out the part between the lines. Full arm blows fell on the lines with absolute accuracy to define clean cut edges before the parts between were roughly hewn out. Defining the interior or hold (*roto*) with the axes was termed

hakatere ki toki ti roto. After the defined area had been chopped out to a shallow depth, other men carried on the hollowing-out process (*hoto*) with steel gouges lashed to short handles like those of the adzes. Some shell adzes made of thicker than average shell and with curved, convex cutting edges were readily recognized by the older men as the type used for hollowing out the hold, hence termed *toki hoto waka.* (See figures, 102, 103, *c.*) After the hold was deepened a few more inches, the work was suspended, for it was late afternoon. The hull was covered with coconut leaves and left to season for a month or so before removal to Werua for completion of the canoe under the direction of Hakaripi.

A midday meal was served at the working place. Various preparations, such as *puraka* in green nut casseroles and in leaf packages, were brought to the workers and to us. To our surprise, hot tea sweetened with sugar but without milk was served to us and to all the workers. The major feast with roasted pork was served to the workers on the beach after they concluded the day's work, but we did not wait to share what we had not earned.

We received another invitation to the building of a canoe on the island of Hare, at the property of Taikuru, who was having it built for his son. When our party arrived by canoe, we went to the place where we saw the smoke of the cooking fires and found women busy preparing food for the working party. One of the women immediately spread out a coconut-leaf mat, placed a pandanus-leaf mat on it, and invited us to rest (*hakamaroro*) a little before going on to view the work. We were no sooner seated than our hostess took two leaf packages from one of six large coconut-leaf baskets filled with similar packages. When she unwrapped them on a dish, they proved to be ripe breadfruit stuffed with coconut cream. She disappeared and returned with a long slab of cooked tuna, after which she brought a pot of hot tea, sugar, and porcelain cups. Though we had eaten, we could not well refuse the hospitality and good will, so we endured a second breakfast. On the way to the canoe site, we found the workers in a shady grove also having breakfast, and it was with extreme difficulty that we escaped a third breakfast.

The breadfruit tree had been felled and the keel side, or *pa,* had been completed by Taikuru and his son, but the turning of the log required assistance. An invitation had gone forth, and the canoe builders of Touhou and Werua had gathered as they had at Ringutoru. As on the previous occasion, Ti Rongorongo, in his pandanus mat skirt, was there to conduct field operations. The various processes were identical with those at Ringutoru. The hull was turned to the old refrain and, curiously enough, it again took three *eps* to complete the turning. The length of the hull was 30 feet 4 inches, the depth 4 *anga* (finger spans). Allowing for what had been removed, the breadfruit trunk

must have been 3 feet in diameter. A flat roof of coconut leaves had been erected by Taikuru over the length of the log to protect it from the sun.

We enjoyed a midday meal provided for the workers by Taikuru's family, and it was here that we were introduced to a fruit salad composed of raw ripe breadfruit broken up with the fingers into small pieces, but served without coconut cream. We took notes and photographs, but when we saw the women approaching with the afternoon meal, we escaped to our canoe, paddled back to Touhou to sit down to canned sausages and macaroni washed down with tea.

We left the atoll before the two hulls were seasoned, regretting that we could not wait to see the finishing technique under the direction of Hakaripi.

KAPINGAMARANGI CANOE

A study of the Kapingamarangi type of canoe was made on the two surviving canoes with outriggers, with Alfred Patterson as chief informant. Though he and other experts no longer make the full-sized canoes for present use, they are all conversant with the building of them and make models for sale or, more often, as presents for visitors. Though they are interesting as souvenirs of a visit to a remote atoll, they are misleading for study purposes, for they are out of proportion, the head and stern end pieces are made in one piece with the hull, the washstrake is left out, and the float connectives are often lashed erroneously with the undercrossed Nukuoro technique. However, the type model in Bishop Museum (C.10110) illustrates the salient features (fig. 107).

Of the two surviving canoes, the smaller one, at Werua, was being discarded and was propped up on the edge of the beach without any cover. The stern projection had been broken off and the aft parts of the gunwale rail were missing. The fore main boom had been broken and but roughly joined with a splint. However, the outrigger apparatus was complete, so we fitted the canoe up with one of the pandanus sails for pictorial purposes (fig. 108, *a*). Alfred Patterson sailed it, but it leaked so badly that his time was occupied with bailing.

The larger canoe, in a canoe shed at Touhou, had the bow piece broken off, but the canoe was in usable condition. We dragged it out of the shed for detailed examination and two men launched it and paddled it off shore (fig. 108, *b*).

Some of the general terms used are as follows: canoe, *waka;* bow, *ngutu ti waka;* stern, *muri ti waka;* hold, *roto ti waka;* bilge, *riu;* weather or outrigger side, *pahi i ama;* offside or leeside, *pahi i katea.*

In the terms for the outrigger and offside, the word *pahi* means side. The use of *ama* (outrigger float) and *katea* (opposite to outrigger) is identical with the usage in Polynesia.

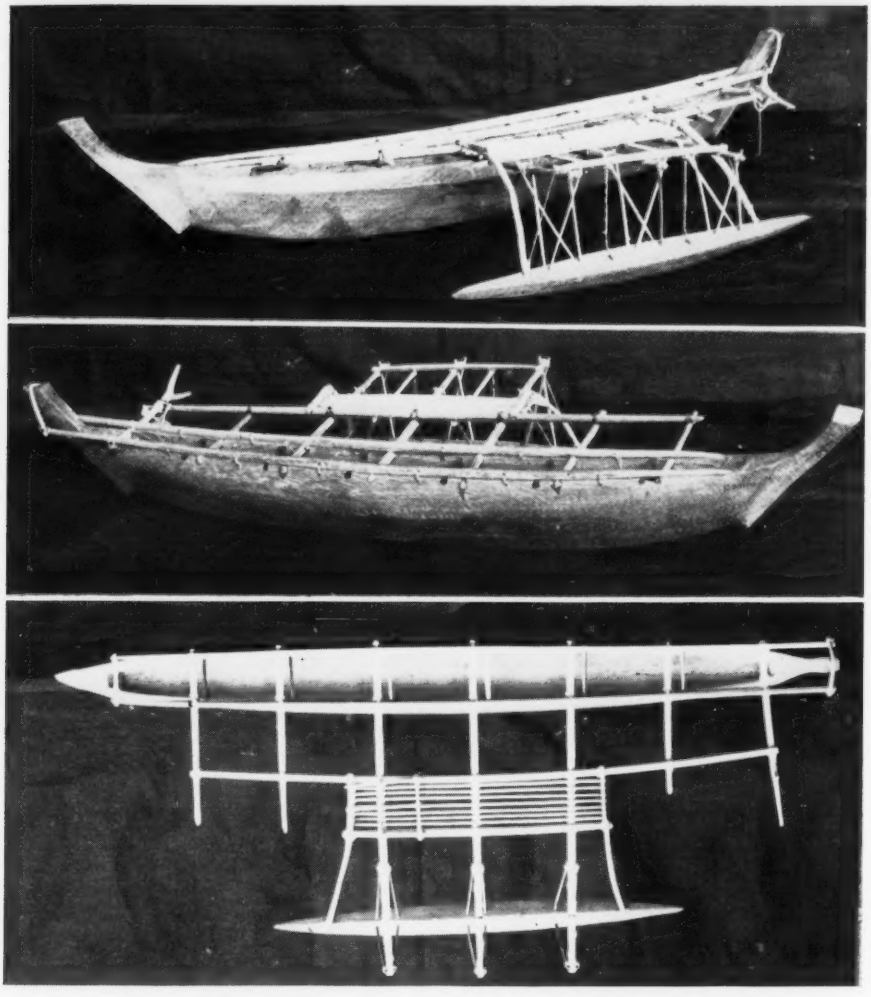

FIGURE 107.—Kapingamarangi model canoe.

HULL

The Kapingamarangi hull consists of various parts which are shown in figure 109, *a* and named in the legend.

The hull of the smaller canoe is 18.5 feet long and the over-all length with the two end pieces is 20 feet 7 inches. The inside measurement of the hull width at the middle is 9 inches, at the gunwale rails, 10 inches.

The hull in the larger canoe from bow piece to stern is 31 feet over all, but the end pieces project beyond the ends of the dugout underbody. The

keel is straight and sloped up in equal curves to the end pieces, the sheer being termed the *maringaringa*. A local characteristic is a small convex projection on the sheer at each end, termed *puiha rore*. On the outrigger side, there is a longitudinal bulge termed the *huai ama*. The fore and aft ends are cut with a slight downward slope with a transverse jog or what Hornell (*7*, p. 397) terms a "heel," for locking with the end pieces. Holes are bored 0.5 inch below the upper edge and 7 or 8 inches apart to correspond with the lashing holes in the washstrake.

FIGURE 108.—Kapingamarangi canoes: *a*, with pandanus sail (Lathrop photograph); *b*, with paddle.

In transverse section, the bottom slopes upward sharply into vertical sides which, however, curve in slightly toward the upper edge (fig. 109, *b*). This may have been influenced in later years by the builders' familiarity with the tumble-home hull of the Nukuoro type, for the canoe in the Hamburg Museum, examined by Hornell (*7*, p. 397), had vertical sides. The wider opening of the hold is termed *mataraunui*, as contrasted with the narrower Nukuoro opening which is termed *matakiki*.

END PIECES

The two end pieces (*hatura*) are fitted over the head and stern (fig. 109, *a*, 2, 3) with a slanting scarfed join which is locked by the jog or "heel" corresponding to that on the hull (fig. 109, *a*, 11). The jog is termed the *kenu*, and the part external to it receives the curious name of the *masud* (*ti masud*). All attempts to get an explanation of the word or a more Polynesian form ended in the reply that it was *ti masud* and nothing else. Both end pieces have a horizontal part which fits over the solid part of the hull beyond the hollowing out of the hold, this part being termed the *papa*. The sides follow the curve of the bow. The inboard ends are slightly winged to connect with the ends of the washstrake. The forward end of the bow end piece (*hatura i ti ngutu*) projects upward to form a figurehead which is quadrangular in section and cut off horizontally at the top. The stern end piece (*hatura i ti muri*) has a similar upward projection, which is shorter than that of the bow.

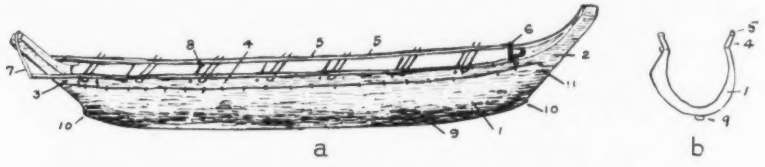

FIGURE 109.—Kapingamarangi canoe. *a*, hull: 1, dugout underbody; 2, head endpiece (*hatura i mua*); 3, stern endpiece (*hatura i muri*); 4, washstrake (*kauo*); 5, gunwale rail (*kaukau*); 6, forward connecting bar between rails (*matangara i ti ngutu*); 7, curved brace connecting gunwale rails (*matangara i ti muri*); 8, thwarts (*manu*); 9, keel (*iwi*); 10, bow and stern projections (*puiha rore*); 11, jogged joint (*kenu*). *b*, cross section.

WASHSTRAKES

The two washstrakes (*kauo*) are lashed to the upper edges of the hull to increase the freeboard, and at their ends they are lashed to the wings of the end pieces (fig. 109, *a*, 4). They are made of dressed breadfruit wood in varying lengths and about 1 inch thick, the pieces joined together with straight oblique joins by one lashing passing through a hole in the middle of each side (fig. 110, *a*). In the middle of the hull, they are 4 inches deep; and at the ends, they conform to the depth of the wings of the end pieces, to which they are lashed with a vertical join, also through holes in the middle of each. A short piece in the middle is 28 inches on its lower edge and 38 inches on the upper edge, thus giving a slant of 5 inches to the joins on either end (fig. 110, *b*).

Holes are bored along the lower border, 0.4 inch above the edge and 7 to 8 inches apart to correspond with the holes in the upper edge of the hull. Vertical turns of the lashing cord are made between the paired holes of the

washstrake and hull, the commencement end being fixed by the subsequent turns passing over it (fig. 110, *c*). The finishing end is passed through under the last turn and the slack drawn taut to fix it. On the outboard side, the wood between the paired holes is grooved so that the lashing is sunk (fig. 110, *d*). Some lashings are seized. (Vertical seized lashings are termed *mataha*.) In some canoes, there are two holes in the hull to one in the washstrake, and the inverted V-shaped lashing when seized is termed *mataha mangarua*.

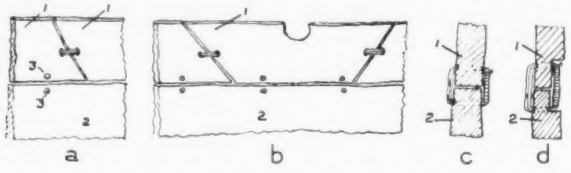

FIGURE 110.—Washstrake joins: *a*, oblique; *b*, middle inset; *c*, simple lashing to hull; *d*, sunken outer lashing to hull: 1, washstrake; 2, hull; 3, paired holes.

The upper edges of the washstrakes are cut to form rounded slots for the ends of the seven booms and are perforated with round holes below the edge for the thwarts.

Some measurements of the larger canoe were taken along the upper edges of the washstrakes, which leaned out slightly from the attachment to the hull. At 5.5 inches from the stern, the width is 5 inches; at 16 inches from the stern, it is 11 inches. The width increases gradually to 14 inches at the middle boom and decreases gradually toward the bow. The inside depth at the middle boom is 19 inches, the outside depth, 21.5 inches.

THWARTS

The six thwarts (*manu*), which are round rods 1.2 inches thick, are inserted in opposite holes in the two washstrakes and project outboard for about an inch on each side (fig. 109, *a*, 8). They are situated a few inches aft of the first six booms, the last or branched false boom being too close to the stern end piece to give space for a seventh thwart. They are supposed to function as seats, but the booms which cross in front of them make better seats.

GUNWALE RAILS

The two gunwale rails (*kaukau*), fitted over the washstrakes after the booms and thwarts are fitted, are made of pieces which fit on the top edge of the washstrakes, and they round off on their upper surface (fig. 109, *a*, 5). They cover the notches with the contained booms and thus add finish to the general upper part of the hull, which is termed the *momo*. Anteriorly the rails end at the forward ends of the washstrakes, but posteriorly they project backward on either side of the stern projection.

GUNWALE RAIL CONNECTIVES

The bow connective, termed *matangara i ti ngutu*, is a straight round bar which rests on the forward ends of the washstrakes and is lashed to them (fig. 109, *a*, 6). It thus crosses the hull a short distance behind the concave posterior edge of the bow end piece.

The stern connective, termed *matangara i ti muri*, is a flexible rod which rests on the top of the stern projection and is bent vertically down on each side to be lashed to the posterior ends of the projecting gunwale rails (fig. 109, *a*, 7).

KEEL

The term *iwi* is applied to longitudinal edges in woodwork, and its application to canoes raises the question of whether it originally applied to a longitudinal edge (fig. 109, *a*, 9) along the middle line of the under surface of the hull or whether it was a separate piece of wood (fig. 109, *b*, 9) attached to the hull in that position. Eilers (2, p. 91) states that "the trunk [hull] is worked into keel shape" and gives (2, p. 94) the native name for "keel" as "ti vi," which is a misspelling of "ti iwi." Modern canoes have a narrow, longitudinal strip of wood (*iwi*) attached to the under surface of the hull in the middle line. However, it is attached to the hull by metal screws and is evidently a modern method of protecting the hull from wear and tear when the canoe is dragged over coral bottoms in shallow water. Had the *iwi* been a separate piece of wood at the time of Eiler's visit, he would surely have mentioned it instead of merely stating that the hull was worked into keel shape.

Outrigger Apparatus

The outrigger is on the left side of the canoe and, in sailing, is always kept on the weather side. The various parts are shown in figure 111.

BOOMS

The three main and the four false booms are made of *woroworo* wood, and are added to the hull after the end pieces and the washstrakes have been placed in position. They are laid athwart the hull at regular intervals, their inner ends being placed in notches cut in the washstrakes of both sides, their outer ends extending on the left side of the hull with an upward inclination. The main booms are connected with the float by stanchions, but the false booms end a short distance beyond the lifting stringer. The two curved booms are connected directly with the float; their inner ends do not reach the hull but end at the lifting stringer. The main and the false booms bear the general

Polynesian name of *kiato* in the dialectical form of *kioto,* and the two forms are distinguished by the qualifying terms of *matua* and *moto.*

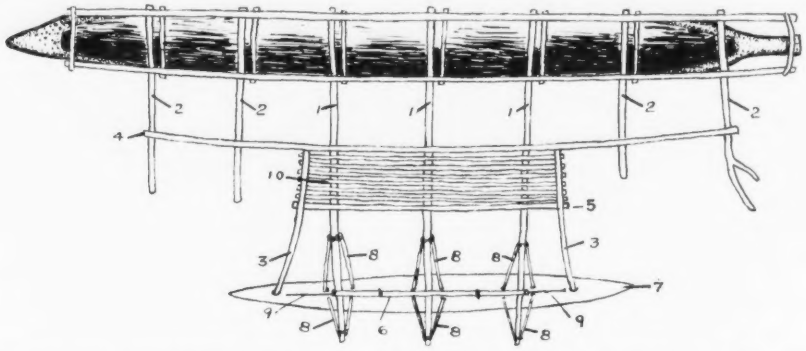

FIGURE 111.—Outrigger apparatus: 1, main booms (*kioto matua*); 2, false booms (*kioto moto*); 3, curved booms (*hapia*); 4, lifting stringer (*hikingawaka*); 5, platform stringer (*rakau pahi i ama hata*); 6, float stringer (*tuatanga*); 7, float (*ama*); 8, float connectives (*hatoto*); 9, float braces (*tata*); 10, platform (*hata*).

The three main booms (*kioto matua*) occupy the middle position (fig. 111, 1), one pair of false booms being forward of them, the other pair aft. The lengths of the three booms diminish from bow to stern; the fore boom being 8 feet 8 inches, the middle boom 8 feet 2 inches, and the aft boom 7 feet 3 inches. The fore boom is the strongest, the thickness at the inner end being 2.6 inches and at the outer end 2 inches. The others are slightly over 2 inches thick at their inner ends and diminish slightly toward their outer ends. The stout poles of which they are made are dressed so that the part over the hull is rectangular, but with the upper edges rounded off. The hull ends are notched slightly on the under surface to fit over the lower edges of the notches cut for them in the washstrakes. On the hull, the fore boom and the aft boom are 4 feet 2 inches from the middle boom. Outboard, the booms slope upward. The booms are crossed by the three stringers and, at their outer ends, are attached to the float by paired connectives or stanchions.

The four false booms (*kioto moto*) are short poles averaging 1.7 inches in diameter at the hull ends and diminishing slightly toward their outer ends (fig. 111, 2). They are fitted into the notches on the two washstrakes and project outward on the left side with an upward inclination for 27 to 31 inches from the hull. They are evenly spaced a little over 4 feet apart. Counting from the bow, the first is 4 feet 8 inches back, and the second is 4 feet 2 inches from the first. It bears the specific name of *kioto hakamau* from *hakamau* (to fasten) because the fisherman's stand (fig. 133) is fastened to it. These two are forward of the foremost main boom.

The first of the aft pair is 4 feet 2 inches aft of the aft main boom, and it receives the specific name of the *kioto heu pa* from the fact that in fishing for bonito the man with the rod stands beside it. He swings (*heu*) the bonito hook (*pa*) on his rod from this position. According to Alfred Patterson, it is now erroneously termed the *kioto tau pa*, in which *tau* means to wring out. It thus has no application to the *pa* hook.

The last boom is 4 feet 6 inches aft of the *kioto heu pa*, and is characterized by a large branched fork which turns upward. From the two-branched fork it receives the name of the *kioto mangarua* from *manga* (branch) and *rua* (two). The large fork with the ends at least 12 inches apart is used for holding the end of the mast, the spars of the folded sail, or the canoe poles. The fork prongs are useful at any time for hanging a coiled fishing line or a basket. The false booms and the main booms give support to a longitudinal stringer which is used to lift the canoe. The branched boom is made from forked branches of the *woroworo, pua,* or *takahoru.*

LIFTING STRINGER

The lifting stringer (*hikingawaka*) is usually formed of a long hau pole, but sometimes it is made of dressed coconut wood (fig. 111, 4). It is stretched over all the seven booms and projects beyond the first and last false booms sufficiently to ensure secure lashings. It is over 2 inches thick at the aft end and 1.75 inches at the forward end. On the forked boom it is 14.5 inches from the hull, on the middle boom 20 inches, and on the first false boom 18 inches. Ample space is available for men to stand between it and the hull to lift the canoe by the stringer.

In carrying the canoe back into the shed, it is always taken stern first; and when the men lift it, they rest the stringer on their right shoulders. The name of the stringer is derived from its function in lifting (*hiki*). The stringer steadies the booms, as the purlins of a house do the rafters. In addition, it forms the inner boundary of the outrigger platform.

In the Cook Islands, a similar lifting stringer is attached to the outrigger booms, but as it is lashed close to the hull, the person lifting the canoe stands on the outer side of the stringers (Hiroa, 6, pl. 10, *A*).

FLOAT

The float (*ama*) is added after the lifting stringer has been firmly secured and so helps to steady the three main booms (fig. 111, 7). Its length in the larger canoe was overlooked but in the smaller canoe, it is 8 feet 11 inches in relation to a hull length of 18.5 feet. It is made of dressed breadfruit wood which is evenly pointed at each end. In the Hamburg Museum canoe described by Hornell (7, p. 398), the float is flat above and rounded below, but in the

large Kapingamarangi canoe being described, the float has four edges: superior, inferior, and two laterals. Hence, the description by Patterson, "Ti ama e ha ono iwi" (The float has four edges). It is attached indirectly to the three main booms by two pairs of connectives to each, which involves the drilling of six pairs of holes in the float. In addition, larger single holes are drilled to the outer side of the end connectives for the lower ends of the curved booms. Finally, the float is lashed to the float stringer by four cord braces. The distance of the float from the hull at the aft main boom is 5 feet 8 inches and at the fore main boom, 6 feet 3 inches. Thus, the float is not quite parallel with the axis of the hull, but is inclined forward and outward.

FLOAT CONNECTIVES

The float connectives or stanchions (*hatoto*) consist of two pairs to each of the three main booms (fig. 111, 8). They are long, somewhat slender rods, 0.5 inch thick, and were formerly made of the hard outer wood of pandanus trunks, but in the later canoes are made of a wood termed *pu* imported from Ponape.

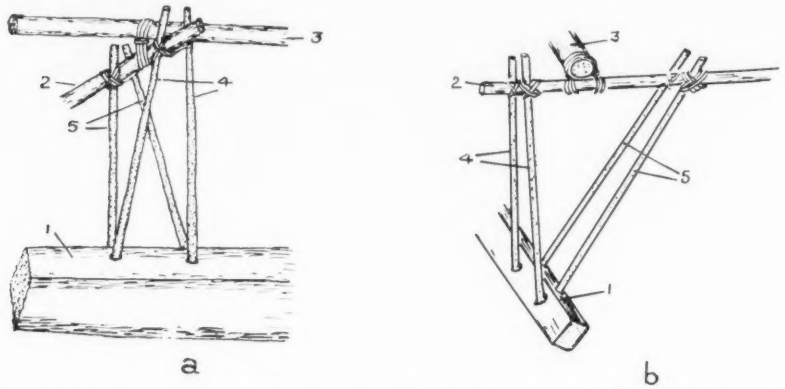

FIGURE 112.—*a*, *b*, float connectives: 1, float; 2, main boom; 3, float stringer; 4, outer pair of connectives; 5, inner pair of connectives.

The stanchions are arranged in an outer and an inner pair for each boom (fig. 112, *a*, *b*). The outer pair on the middle boom is 17.5 inches long and the lower ends are inserted in holes on the outer slope of the upper surface of the float, 4.5 inches apart (fig. 112, *a*, 4). They slant upward and inward to rest against the sides of the middle boom, which is 1.5 inches in diameter. The pair slant outward very slightly from the vertical line between the float and boom.

The lower ends of the inner pair are inserted into holes on the inner slope of the upper surface of the float, opposite the holes for the outer pair, from

which they are separated by the median edge and a space of but 1.8 inches. They slant upward and markedly inward to embrace the boom, the distance between the upper ends of the two pairs being 15 inches (fig. 112, *b*, 5). The arrangements of the stanchions with the other two booms are similar.

One of the inner stanchion pairs on the small canoe was loose, so Alfred Patterson relashed it and then demonstrated the technique on an outer pair as described below and shown in figure 113, *a-i*.

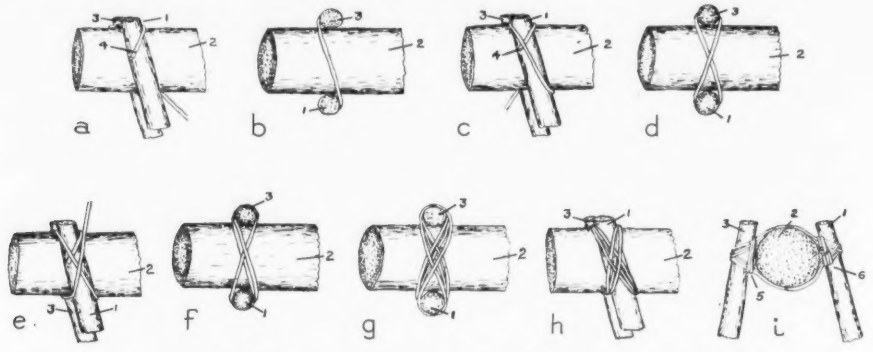

FIGURE 113.—*a-i*, lashing float connectives to main boom: 1, near stanchion; 2, main boom; 3, far stanchion; 4, cord commencement; 5, circumferential turns; 6, finish of circumferential turns.

In *a*, using a workman's coil, the end (4) is laid on the outer side of the near stanchion (1) and the cord passes around its right side, crosses obliquely over the boom (2) from the right to left to the left side of the far stanchion (3), crosses obliquely down over its outer surface to the right, crosses transversely under the boom and appears at the lower corner on the right of the near stanchion (1).

In *b*, is shown the upper surface of the boom (2) and the first oblique turn from right to left between the near (1) and the far (3) stanchions.

In *c*, the cord crosses obliquely upward from the right lower corner over the outer surface of the near stanchion and crosses over the commencement end (4) to fix it. It passes obliquely over the upper surface of the boom from left to right to pass on the right of the far stanchion (3) and descends obliquely over its outer surface to appear in the lower far left corner.

In *d*, the second oblique turn on the boom crosses over the first from left to right. This establishes the technique for subsequent turns.

In *e*, from the far left lower corner, the cord passes transversely under the boom to the near left lower corner, and turns obliquely upward toward the right on the near stanchion (1) to be parallel with the commencement turn.

In *f*, from the right of the near stanchion (1), the cord makes a second oblique turn from right to left to pass on the left of the far stanchion (3), descend obliquely on its outer surface, and repeat as in *a*.

In *g*, is shown that by making two crossing turns on the right of the first two crossing turns (*d*) and two on the left, a lozenge pattern is produced on the upper surface of the boom (2).

In *h*, a similar lozenge pattern is formed on the outer surface of the two stanchions by observing the same procedure.

And in *i*, the lozenge pattern having been completed on the far stanchion (3), some circumferential turns (5) are made around the lashing turns between it and the boom (2). The cord then crosses under the boom to make similar turns around the lashing turns between the near stanchion (1) and the boom. These last turns are loose to allow the coil to pass through them. The turns are drawn taut, the coil passed through the slack loop to form an overhand knot, the slack drawn taut, and the cord cut (6).

The float connectives in the old canoe and the form of lashing thus described show definitely that though Kapingamarangi canoes have local features in the use of three main booms and two curved booms, the connectives are lashed against the sides of the boom and thus retain the general Polynesian technique. Some of the Kapingamarangi model canoes have the connectives crossed under the boom, but this has been due to the late influence of building canoes of the Nukuoro type. Alfred Patterson was very definite in his statement "Na mua nia hatoto e hau i pahi taha o ti kioto, akare rawehaki. Ti rawehaki, e me hou mai Nukuoro." "In former times, the float connectives were lashed against the sides of the boom, never undercrossed. The undercrossing is a new thing from Nukuoro."

PLATFORM STRINGER

A stringer formed of a *woroworo* pole 1.7 inches in diameter is laid across the three main booms, and in the larger canoe about 18 inches from the lifting stringer and parallel to it (fig. 111, 5). It is firmly lashed to the three booms, and the ends project far enough outward to give support to the curved booms when they are placed in position. From its position on the side of the platform (*hata*) toward the float (*ama*), it receives the descriptive term of *ti rakau pahi i ama hata* (the wooden element on the float side of the platform). It not only serves to form the outer boundary of the platform, it helps to stiffen and brace the curved booms.

CURVED BOOMS

The two curved booms (*hapia*) are formed of *woroworo* branches 4 feet 1 inch long and 1.5 inches thick (fig. 111, 3). (In the small canoe, they are 4 feet 5 inches long, 1.1 inches thick, and the distance between them on the float is 7 feet 2 inches.) One is forward of the fore main boom and the other aft of the aft main boom. Their inner ends rest against the outer side of the lifting stringer, to which they are attached by a T-join. A vertical hole is made at the ends of the booms and the lashing cord passes through it and around the stringer. A similar technique is used in various parts of the house frame, such as the lashing of the thatch rafters to the eaves batten (fig. 36, *d*). The booms project horizontally for 18 inches to rest on the platform stringer to which they are lashed. From the platform stringer, the booms slope downward to

meet the float into which they are inserted. Some booms are formed of branches, in which part of the main stem is the horizontal part and from which the lesser branch inclines downward at the correct angle to meet the float.

The reason given for the addition of the curved booms is that they give greater security. The float connectives are liable to break if a heavy sea strikes broadside against the outrigger float, but the curved booms would keep the float connected with the outrigger apparatus should such an accident occur.

FLOAT STRINGER

The third outrigger stringer (*tuatanga*) also consists of a *woroworo* pole, a little over 8 feet in length and 1.8 inches thick (fig. 111, 6). In the small canoe, it is 5 feet 5 inches long and 1.2 inches in diameter. It is laid over the outer ends of the three main booms, above the float, and thus provides support for four suspensory braces with the float.

FLOAT BRACES

The float braces (*tata*) are four in number, one at each end and two in the intervals between the three main booms (fig. 114). Each brace is formed of a

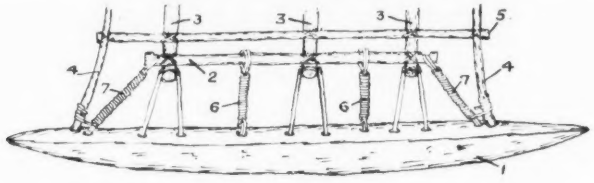

FIGURE 114.—Float braces: 1, float; 2, float stringer; 3, main booms; 4, curved booms; 5, platform stringer; 6, vertical braces; 7, end braces.

cord which passes around the float stringer above and then downward to pass through a V-shaped hole in the float, the hole being bored from each side of the median edge to meet transversely below it. Two complete rounds are made between the stringer and the float, and the four lengths are then seized throughout their length. The two intermediate braces are vertical. The two end braces pass around the end notches in the float stringer and then obliquely to their float holes which are made close to the holes for the insertion of the curved booms in the float. The seizing of the end braces commences above; and at their lower ends, some seizing turns are made around the adjacent lower ends of the curved booms. The float stanchions maintain the correct distance between the float and the booms, but in carrying the canoe before and after use, the weight of the float is liable to detach it from the inserted ends of the stanchions. However, the braces prevent this from happening.

PLATFORM

The platform (*hata*) is useful for carrying material where it is less liable to become wet than in the hold (fig. 111, 10).

It is bounded by the lifting stringer on the inner side, by the platform stringer on the outer side, and fore and aft by the horizontal parts of the curved booms. Its floor is formed of fore and aft poles resting on the three main booms and lashed at their ends to the under side of the curved booms. In the middle of the intervals between the main booms, cross pieces are lashed to the under side of the floor poles, and their ends are lashed to the lifting stringer and the platform stringer.

In the old canoes, an enclosure termed the *koro manga* was made on the fore part of the platform. It was used to hold drinking nuts and food. In fact, the name was derived from *koro* (to desire) and *manga* (food). There was some sort of ritual in which the nuts formed a symbolic offering to the gods, but the practical use of the nuts was not denied to their followers.

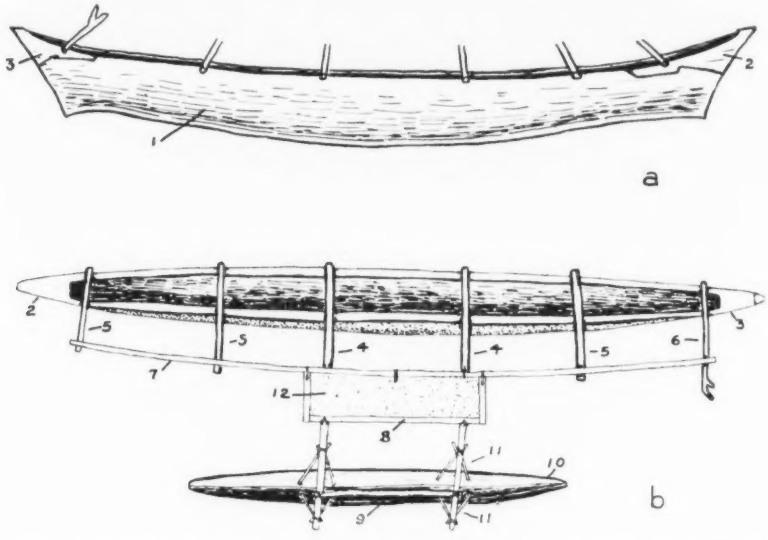

FIGURE 115.—Nukuoro canoe model. *a*, hull: 1, hull; 2, bow piece; 3, stern piece. *b*, outrigger: 2, bow piece; 3, stern; 4, main booms; 5, false booms; 6, forked false boom; 7, lifting stringer; 8, platform stringer; 9, float stringer; 10, float; 11, float connectives; 12, platform.

NUKUORO CANOE

The Nukuoro type of canoe adopted by Kapingamarangi differs so materially from the Kapingamarangi type that it seems remarkable that two atolls so closely situated should have developed such divergent types.

The Nukuoro type is characterized by a tumble-home hull without the longitudinal bulge (*huai ama*) on the outrigger side and without the knobs (*puiha rore*) on the bow and stern sheers. It is without washstrakes and gunwale rails and consequently without the bow and stern connectives joining the ends of the rails. It has the bow and stern pieces (*hatura*) with upward projections. The bow and stern sheers from the keel slant upward in more abrupt lines that approach a cutwater (fig. 115, *a*).

The outrigger apparatus (fig. 115, *b*) is much simpler than that of the Kapingamarangi canoe. It has two main booms instead of three, no curved booms but the same number of false booms, two fore and two aft with the last one branched. The lifting stringer is used, but owing to the upward curve of the booms, both it and the outrigger platform are elevated more than in the Kapingamarangi canoe. The float follows the Kapingamarangi pattern but the float stanchions are crossed under the booms. The cord brace is different in having its upper ends attached to the main booms and having no connection with the float stringer. Some typical canoes are shown in figure 116.

FIGURE 116.—Nukuoro type of canoes.

The following details are based on a canoe selected for Richard B. Black by King David at Kapingamarangi. It is a well-made canoe and may be accepted as typical of the present technique. For individual canoe parts reference is made to figure 115, *a*, *b*.

The hull length including the end pieces is 30 feet 2 inches, and the keel length is 27 feet 10 inches. The sides of the hull curve inward above the middle line and then horizontally to the edges of the hull opening for 2 inches at each end, gradually increasing to 3 inches amidships. The thickness of the inner edges is 1.1 inches amidships to 1.75 inches at the ends. The hull opening is 8.25 inches wide amidships, decreasing to 4.25 inches at each end. The interior depth amidships is 19 inches and the outside depth is 22 inches, giving 3 inches for the thickness of the bottom of the hull inasmuch as the keel has been detached. The greatest interior width amidships is 17 inches, whereas the hull opening above is only 8.25 inches. Holes are bored horizontally through the sides of the hull, 1.75 inches below the upper flat surface and one for each of the six booms. Both the keel and the upper line of the hull curve upward; and the upper hull sheer is 11 inches, between the raised end pieces, 23 inches. The sheer was measured for me by Commander Black, who took the vertical measurement from the middle of the line connecting the ends of the curve. With the hull resting on the ground, each end of the keel is 9 inches above the ground.

The end pieces (*hatura*) are similar to those of the Kapingamarangi canoe but do not rise so high (fig. 115, *a*, 2, 3). The bow end piece of the Black canoe consists of a solid piece of wood, triangular in cross section, and converging to a blunt point above. The front edge continues the bow sheer of the hull, and the two side surfaces blend in with the sides of the hull. The posterior surface has a long concave slope which extends back over the hold. This aft horizontal part is cut away in the middle to form the upper fore end of the hold. The hollowing out of the middle part results in two lateral arms which are trimmed to fit in with the sides of the hull and also its level upper surface. The two aft limbs are of different lengths, one being 18.5 inches long and the other 28 inches. The fore end of the hull is cut down at a forward slant for a depth of 4.5 inches, carried forward for 13 inches, turned upward with a forward slant of 2 inches to form a jog, and then forward to the bow edge at a slightly downward slant for 6.5 inches. These measurements are repeated on the under surface of the end piece so that it fits perfectly over the hull. The jog, which is very important, receives the special name of *kenu*. The end piece is secured to the hull by paired holes through the aft limbs of the end piece and the hull. A vertical groove is cut between the holes on the outer side so that the seized lashing is sunk below the surface. Another pair of holes is bored through the end piece and the hull not far back from the anterior edge; and as both end piece and hull are solid but narrow, the holes pass right through from side to side. Vertical grooves are cut so that the lashings are sunk below the surface. When the canoes are painted, it is difficult at first glance to distinguish the position of the lashings. The length of the concavo-convex sheer from the keel to the apical point of the bow end piece is 45 inches.

The main booms (fig. 115, *b*, 4) are 7 feet 9 inches long. The inboard ends which are straight for 13.75 inches fit over the upper level parts of the hull on each side. The straight parts are squared and the upper edges then rounded off, the diameters being 2.7 inches horizontally and 3.3 inches vertically. The outboard part, which is 6 feet 5.25 inches long, rises from the hull with an arch 4 inches high. This high part supports the narrow platform, and the booms then slope downward to become horizontal at their outer ends, which are squared to 2 inches in both diameters but with the lower edges rounded off. They are lashed to the level parts of the hull on which they rest by turns passing through the holes below them on the sides of the hull and around the free edge of the hull opening (fig. 117, *a*). The turns are crossed diagonally on the upper surface of the booms to form the lozenge pattern and finished off with circumferential turns passing around between the booms and the upper surface of the hull (fig. 117, *b*). On the outer side of the hull, the turns passing down and up on either side of the wide boom and through the single hole below, form a V-shaped pattern (fig. 117, *c*).

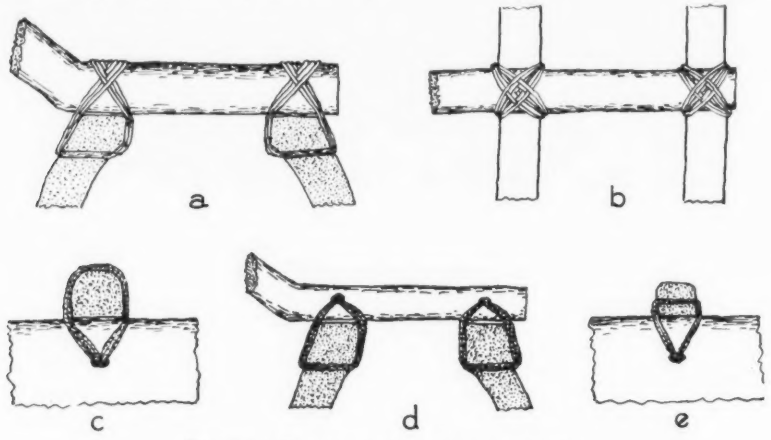

FIGURE 117.—*a-c*, lashing booms to hull.

The false booms (fig. 115, *b*, 5, 6) have an inner straight part like the main booms. Some of them are cut on the under surface to fit over the flat parts of the hull. Their diameters are 2.2 inches horizontally and 2.5 inches vertically. The fore and aft end booms are lashed to the hull in the same way as the main booms, with the lozenge pattern above. The other two booms, however, are pierced with fore and aft holes through the middle of the booms to correspond with the middle of the flat upper surface of the hull. Thus the lashing turns which pass through the single hull hole below instead of passing over the upper surface of the boom pass through the hole in the boom. The turns develop an inverted V-shaped pattern on each of the booms (fig. 117, *d*) and

the usual V-shaped pattern on the outer side of the hull (fig. 117, *c*). The outboard lengths of the booms are 2 feet 3 inches and they rise with a curve similar to that of the main booms.

The lifting stringer (fig 115, *b*, 7), which is a hau pole, is 26 feet 11 inches long and has a stern thickness of 2.2 inches and a bow thickness of 1.9 inches. It rests on the upper surface of all six booms at a distance from the hull of 13 inches at the stern to 19 inches amidships. It is lashed to them all with the typical local technique (fig. 84, *b*, *c*) which forms a lozenge pattern on the upper surface of the stringer and an elliptical pattern on the under surface of the booms. After the patterns are developed, circumferential turns are made around the lashing between the stringer and the boom. The ends of the false booms project outboard beyond the stringer for about 7 inches.

The platform (fig. 115, *b*, 12) is bounded by the lifting stringer on the inner side and the platform stringer on the outer side. The platform stringer (fig. 115, *b*, 8) is 6 feet 7 inches long and is lashed on the upper side of the main booms 20 inches from the lifting stringer. Cross bars are lashed to the ends of the platform stringers and the lifting stringer. The floor of the platform is formed of boards. It is common to make two floors with a space between as a convenient resting place for paddles.

The float stringer (fig. 115, *b*, 9), 4 feet 10 inches long and 2.2 inches thick, is lashed above the two main booms with the lozenge ellipse pattern. It is in an approximately vertical line above the float and braces the outer ends of the main booms.

The float (fig. 115, *b*, 10) is 13 feet 9 inches long with a middle width of 11.25 inches and depth of 9.75 inches. It is four-sided with two upper inclined surfaces divided by a well-marked median edge. From its greatest size in the middle, it gradually diminishes to a point at each end. Two pairs of holes are made on the outer upper surface for the outer stanchions and two opposite pairs are made on the inner upper surface for the inner stanchions. Each pair of holes is 8.5 inches apart and opposite pairs are 2.25 inches apart across the dividing median edge.

The stanchions (fig. 115, *b*, 11) are rods 1 inch thick with pointed lower ends and about 25 inches or more long. The float is adjusted so that the booms are above the middle of the paired holes. The upper ends of the outer stanchions meet the booms near their outer ends, and the float is chocked up so that the inner stanchions which slant inward will form a similar angle with the outer stanchions and thus indicate where their upper ends should be lashed to the boom. The outer and inner pairs are crossed under the boom (fig. 118, *a*), pressed against its sides, and hammered down into the float holes. The outer pair is lashed to the boom first with the same technique as in the Kapingamarangi canoe (fig. 113). In the Black canoe, the length of the stan-

chions from the edge of the float holes to their upper ends, which project above the booms, is 21.75 inches; the distance between the upper ends of the outer and inner pairs on the boom is 27.5 inches; and the vertical distance between the upper median edge of the float and the under surface of the boom is 11.25 inches. These measurements are the end results of the adjustments made by eye, hence any extra length on the stanchions is cut off. The lashing of the inner stanchions to the boom is made in the same way as with the outer ones, and the extra cord may be used to commence the cord brace. The relationship between the boom stanchions and brace is shown in figure 118, *b*.

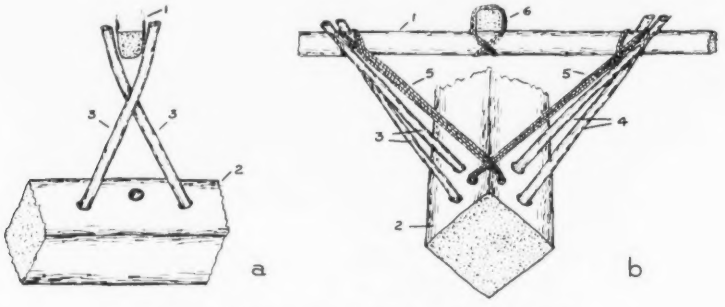

FIGURE 118.—*a*, *b*, float stanchions and braces.

The cord brace (fig. 118, *b*, 5) on the aft main boom commences from the upper attachment of the inner pair of stanchions. The cord, after passing around the projecting upper end of the stanchion on the fore side, crosses the boom obliquely to its aft side, passes down to the outer side of the V-shaped hole through the float, passes through the hole, crosses itself, and ascends obliquely to the upper lashing of the outer stanchions. It crosses the boom from the aft side and passes around the outer side of the stanchion projection on the fore side of the boom. It makes a downward sweep across the stanchion lashing, ascends on the inner side of the stanchion, and passes obliquely over the boom to cross the previous turn at an acute angle. It descends to the inner side of the float hole, passes through it to the outer side, crosses itself, and ascends to the commencement point. Here it passes to the inner side of the fore stanchion, passes over its lashing on the fore side, appears on the boom on the outer side of the fore stanchion, crosses obliquely over the previous two turns at an acute angle, and descends obliquely toward the float hole. The sequence is now established for the aft boom. With the inner pair of stanchions, the turns pass around the fore stanchion from the inner or hull side, pass around the stanchion to its outer (float) side, cross obliquely over previous turns to descend on the aft side of the boom. On the outer stanchions, the turns pass around the fore stanchions from its outer side, appear on the inner

(hull) side, cross obliquely over previous turns, and descend on the aft side of the boom. On the float, the turns cross one another above the median edge. The brace is V-shaped with two limbs with an equal number of cords. (In the Black canoe, there are six cords in each limb.) Poteke, who demonstrated the brace technique, drew particular attention to the oblique crossings on the boom. On the inner end, because the second return round has to pass to the inner side of the stanchion, two straight turns come together. As the turns then alternate, there are four straight turns and two oblique. On the outer end, the alternation takes place at once, hence there are three straight turns and three oblique. After the last turn to the inner end, the cord is passed two or more times around the six cords near their crossings and tied with an overhand knot to finish the brace.

FIGURE 119.—Nukuoro canoes under sail (top, Lathrop photograph).

With the fore boom, the turns pass around the aft stanchions and on to the float from the fore side of the boom. The cord used has a left-hand twist and is fairly thick. Before commencing the brace, a length of coconut leaflet midrib

is attached to the end of the cord in the same way as the cord used in the attachment of floats to the coir nets. (See figure 137.) The midrib needle enables the cord to be threaded through the float perforation more easily.

A large community canoe of the Nukuoro type with seats for 10 paddlers was kept in the Touhou men's house. It was 45 feet 10 inches long with a keel length of 43 feet 5 inches, and the float was 19 feet 9 inches long.

Nukuoro canoes under sail are shown in figure 119.

SAILS

Sails (*ra*) are triangular in shape and used as lateens. They are now made of canvas, but were formerly made of pandanus matting. We were fortunate in finding two old sails in good condition on Touhou and properly fitted with yards and booms. They were made of long narrow panels of plaited pandanus leaf, nine to 10 inches wide, and of the same technique as the strip already described (fig. 73). The panels were plaited in check along the two long edges and in twilled-twos between. One sail was 13 feet 3 inches long on the front border attached to the yard, 16 feet 9 inches along the lower border attached to the boom, and 13 feet 11 inches along the posterior free border. It was composed of 19 strips laid parallel with the yard and thus gradually shortening in length from the yard to the outer end of the boom (fig. 120).

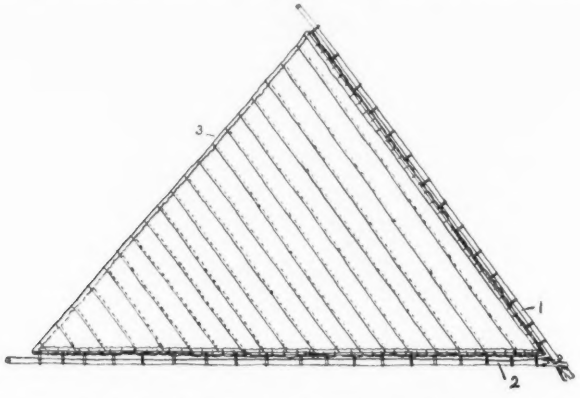

FIGURE 120.—Pandanus mat sail: 1, yard; 2, boom; 3, tack.

The strips of matting cut to length were overlapped for an inch along the edges and sewn together with a running stitch of right-hand cord, the stitches about an inch long.

The method of fixing the edges of the triangular sail is shown in figure 121, *a-c* and described below.

As shown in *a*, the right edge of the marginal strip is doubled over a thick left-hand cord (1) and the edge sewn to the body of the strip with a right-hand cord (2) in running

stitches, as in joining the strips together. The enclosed cord is 5 mm. thick with 3 twists to the inch, and the sewing cord is 3 mm. thick with 7.5 twists to the inch. A thick left-hand cord (3) of the same size as the enclosed cord is then laid along the full length of the doubled edge and attached to it by a thin right-hand cord (4) which makes half-hitches at 2.5 to 3 inch intervals around the enclosed cord (1) and the marginal cord (3) by passing through the doubled matting beyond the enclosed cord (1). (Though the sail is not attached to the yard immediately, the method is shown to complete the drawing.) The sail is lashed to the yard (5) by tying the marginal thick cord (3) and the binding cord (4) to the yard with two turns (6) of a right-hand cord tied with a double overhand knot. These ties to the yard are made at intervals of 11 or 12 inches.

The ends of the matting strips along the line of the boom are cut obliquely to follow the triangular shape of the sail. The method of treating the lower, or boom, edge is shown in *b*.

In *b*, the lower, ragged, cut edge of the sail is doubled over a thick left-hand cord (1). The edge is sewn to the body of the plaiting with a twine of two cords (2) which pass through both layers and make a half twist around each other, each twist being 0.5 inch long. The marginal thick cord (3), the half-hitches with the thinner cord (4), and the attachment of these two cords to the boom (5) with spaced double overhand knot ties (6) are exactly the same as in the yard.

The tack, or free edge of the sail between the ends of the yard and the boom, is termed *ti hanga*. Here the ends of the matting are also cut obliquely; but as it is not tied to a spar, all it needs is the enclosed bolt rope and the sewing down of the folded edge, as shown in fig. *c*.

In *c*, the left-hand cord (1) serving as a bolt rope is enclosed in the fold of the cut edges which are sewn down with a single pair twine (2) in the same way as with the boom edge.

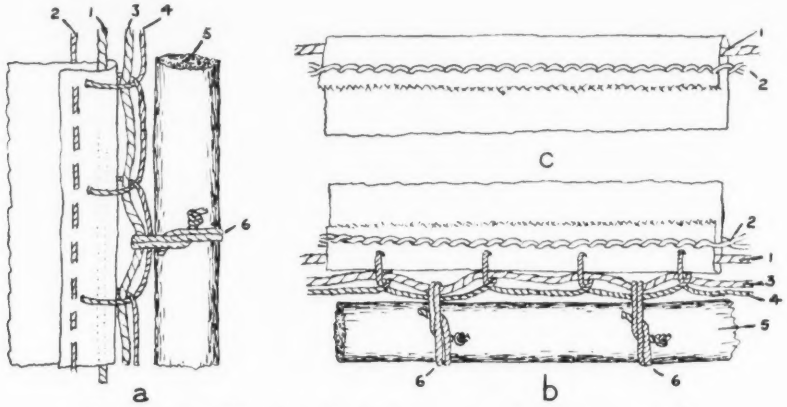

FIGURE 121.—Fixation of sail edges: *a*, yard; *b*, boom; *c*, tack.

YARD

The yard (*tatu*) is formed of a hau pole, which is joined at its lower end to a forked piece of *woroworo* wood (fig. 122), the forked section being termed *ti tono tatu*. The forked section is 26.5 inches long and, above the fork, 2 inches thick. The fork limbs have an outer spread of 4.4 inches at their ends, and the ends of the two limbs are 1.2 inches thick. The fork section is joined to the

hau pole with a slanting join 14.5 inches long. It has a jog as shown in the figure, the lower part to the jog being 10.5 inches and the upper part from the jog being 4 inches. The lower end of the hau pole is shaped to fit, and the two are joined together by three spaced lashings, each with six or seven close transverse turns, the end ones overlapping the ends of the join (*hukuinga*). Above the join, the hau pole is 2.2 inches thick, at its upper end, 1.2 inches thick. The total length of the yard is 14 feet 7 inches.

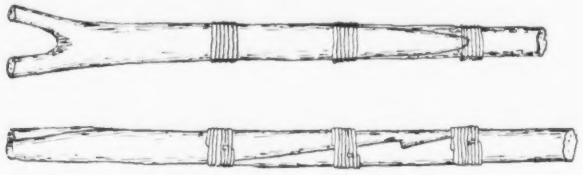

FIGURE 122.—Forked end splice of yard.

BOOM

The boom (*kotokoto*) is longer than the yard but made in a similar way, of a forked section of *woroworo* wood termed *ti tono kotokoto*, joined to a hau pole with a jogged join (*hukuinga*). The forked section is 22.5 inches in length. Above the fork it is 2 inches thick, and the outer ends of the fork limbs are 1.5 inches thick, with an outer spread of 3.7 inches. The jogged join is slightly shorter than that of the yard, and it has a lashing at each end of seven close transverse turns which cover the ends of the join. The hau pole is 2.1 inches thick in the middle and 1.3 inches at the outer end. The total length of the boom is 17 feet 4 inches.

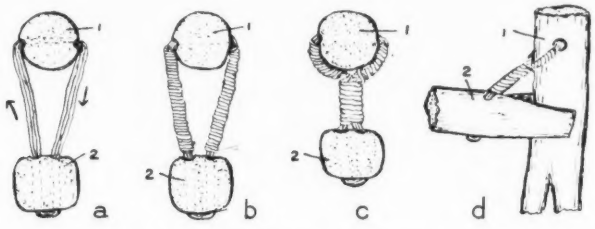

FIGURE 123.—*a-d*, boom attachment to yard.

The boom is connected with the yard by a cord lashing which allows play between the two spars. The yard has a hole bored transversely through the middle about 11 inches from the end of the fork. The boom has two parallel holes close together on the sides corresponding with the open fork and one inch from the branching of the fork. The method of attachment described below is shown in figure 123, wherein the two spars are shown in sections *a-c*.

In *a*, a left-hand cord is passed through the hole in the yard (1) from left to right, the short end being fixed by the subsequent turns of the cord. The cord descends from the right to pass downward through the right hole in the boom (*2*). It passes up through the left hole in the boom and ascends to the left side of the transverse hole through the yard. It passes through and makes three complete rounds. The distance between the two spars is 3 inches. Each of the two limbs of three turns of cord are seized throughout their length (*b*); and in *c*, the two seized limbs are then seized together from below upward to the under surface of the yard (1) and the cord tied with an overhand knot around one of the limbs. The double seizing reduces the play between the two spars to 1.75 inches.

The side view (*d*) shows the relative position of the two spars with the lashing between them.

When the sail is raised, the yard fork rests on the windward gunwale rail of the hull and the boom fork rests against the yard. When the sail is lowered, the yard and the boom can be laid together and the sail wrapped around them.

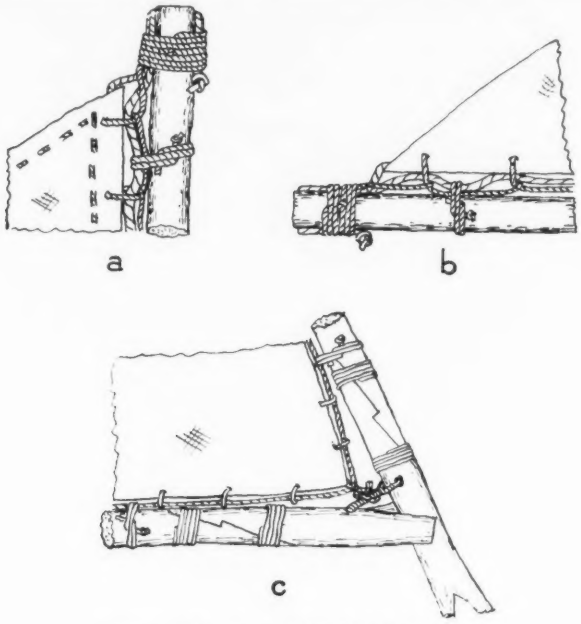

FIGURE 124.—*a-c*, fixing of sail corners.

SAIL CORNERS

In fastening the upper corner of the sail to the upper end of the yard (fig. 124, *a*), the bolt cord and the marginal cord are prolonged beyond the end of the sail, carried along the near side of the yard, over the end in a vertical notch prepared for them, along the under surface of the yard to a point coinciding with the end of the sail, and knotted with an overhand knot. The binding cord is carried forward from the last hitch and makes close transverse

turns around the yard and the two thick cords. This lashing secures the two cords to the yard and the knot prevents them from slipping through the lashing.

The outer bottom corner is fixed to the end of the boom in the same way that the upper corner is fixed to the yard (fig. 124, *b*).

The inner bottom corner at the junction between the yard and the boom has a different attachment. The ends of the two thick cords from each edge are brought together beyond the sail corner and lashed together with one or both of the thinner binding cords from the edges. One pair of the thick cords is then passed around the seized cord connecting the boom to the yard and tied to the other pair with a reef knot (fig. 124, *c*).

The sail is now complete with its yard and boom as a single unit, folded together, and placed in the loft of the canoe shed ready for use.

The other pandanus sail, owned by Tomoki, is similar to the first. Some of the strips of plaiting, however, are plaited in twilled twos throughout and they range in width from 9 inches to 12 inches. It is evident that the strips are not all plaited by the same person. The strips are joined together in the same way with a running stitch. The sewing of the cut edges along the boom and the posterior edge, however, differs in having two rows of running stitches instead of the twined technique used in the first sail. The half-hitches which attach the marginal cord to the sail edge pass over both rows of running stitches instead of just beyond the bolt rope. The fitting of the yard and the boom with forked pieces (*tono*) connected with jogged joints and the attachment of the sail to the spars is the same in both sails. The yard edge of the sail is 11 feet 9 inches long, the boom edge 14 feet 5 inches, and the posterior edge 14 feet 2 inches. The total length of the yard is 13 feet and of the boom 16 feet 2.5 inches.

Hoisting the Sail

In addition to the sail with its two attached spars, a mast and a rope are all that are required in the Kapingamarangi canoe for sailing.

The mast (*pou*) is a straight hau pole 3 to 5 inches in diameter at its lower end. Its length varies to suit the size of sail, being long enough with its forward inclination to raise the sail high enough for the boom to clear the hull. It is carried with the sail wrapped around its two spars, one end resting in the fork of the aft false boom and the other end resting on the main outrigger booms.

A three-ply rope, termed the *tauama*, is used to tie the sail yard to the mast and to keep the mast inclined at the right angle. This rope acts as both shroud and halyard.

To raise the sail, the yard is attached to the mast with the *tauama* rope. The upper ends of the mast and the yard are overlapped together in the

middle of the canoe, the butt end of the mast toward the stern and the forked end of the yard toward the bow. The shroud (*tauama*) is tied to the upper end of the mast with a clove hitch (*no pou*) a short distance from the end of the rope so as to have a short end free beyond the clove hitch. The subsequent procedure, shown in figure 125, *a-c*, is described below.

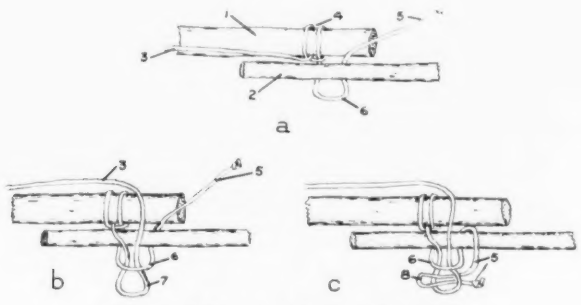

FIGURE 125.—*a-c*, tying yard to mast.

The mast (*a*, 1) and the yard (2) are shown overlapping, the shroud (3) tied to the mast with a clove hitch (4). The short extra end (5) of the shroud is passed under the yard to form a loop (6). The shroud (*b*, 3) below the clove hitch is brought up in a loop (7) over the yard and passed through the short length loop (6). The end of the short length (*c*, 5) is brought over the yard and formed into a loop (8) which is passed through the shroud loop (7). The various loops are drawn taut, and the yard is effectively tied to the mast.

The lashing of the yard to the mast admits of movement between the two so that in hoisting the mast with its sail, the yard has enough freedom to form the required angle with the mast. In lowering the sail, the yard is quickly detached from the mast by pulling the end of the short length (fig. 125, *c*, 5) which releases the last loop (8), and the others (7, 6) follow.

The sail is usually raised (*e ranga ti ra*) by two men. One toward the stern end raises the mast as he steps it against the aft main boom or against the thwart (*manu*) behind it. He holds the shroud with his left hand and, as he elevates the upper end of the mast to the right height, keeps the shroud taut to maintain the mast at its right elevation. Meanwhile, the other crewman has unrolled the sail, and he steps the forked end of the yard on the weather gunwale rail (*kaukau i katea*) near the bow or on the front bar which connects the forward ends of the gunwale rails (*matangara mua*). The man at the mast adjusts the elevation of its upper end until the boom clears the hull.

The boom swings out on the lee side. To counteract the weight of the sail on the lee side, the shroud is passed over the projecting outer end of the middle outrigger boom, pulled or slackened to keep the slanting mast in the middle

line of the hull, and finally fastened to the middle boom on the inner side of the lifting stringer (*hikinga waka*) with a slip hitch (termed *nepe*) as described below and illustrated by figure 126, *a*.

The shroud (*a*, 1) descends from the masthead to pass around the end of the middle boom (2) and over the float stringer (3). It passes inward along the boom to cross the lifting stringer (4), makes a turn (5) around the boom, and is formed into a loop (6) which passes under its standing part and is jammed between it and the lifting stringer. The pull on the shroud keeps the *nepe* hitch secure.

The *nepe* hitch is generally known as the slippery hitch. Ashley (1, p. 19), in his authoritative work on knots, says, "The slippery hitch is often found in the sheets and halyards of small boats. It may be spilled instantly when required, yet it is a perfectly good hitch when properly applied and understood."

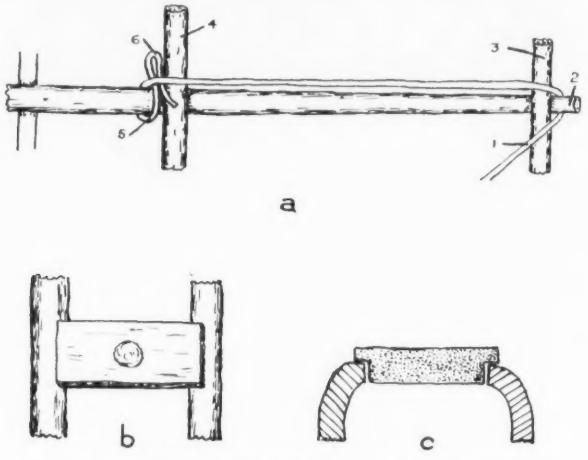

FIGURE 126.—*a*, slippery hitch; *b*, *c*, Nukuoro mast step.

In lowering sail (*e tuku ti ra*), the end of the hitch is jerked and freed instantly. The butt end of the mast is lifted clear of its support and slid backward to lower the upper end. As the lashing of the yard to the mast comes within reach, the fastening is freed instantly by jerking the upper free end of the shroud as already described. If two men are attending to the sail, one man after freeing the mast, lays it in a horizontal position on the forked false boom and the outrigger apparatus; the other, who is forward, lifts the boom to keep it out of the water. He brings the yard and the boom together, wraps the sail around them, and lays the folded sail beside the mast. When one man manages the sail, he simply abandons the mast after separating it from the yard and devotes his attention to gathering in the sail and folding it.

I have seen the mast floating away clear of the canoe, but it is readily recovered after the sail has been attended to.

In sailing, a spiller cord termed *haha* is attached to a cord loop (*tau moko*) on the outer end of the boom. The spiller cord is held by the steersman for slackening out or hauling in the boom according to the strength of the wind.

NUKUORO MAST STEP

A special mast step is used with the Nukuoro type of canoe. It consists of a seat which projects beyond the inturned gunwale, but is cut beneath on each side so as to fit against the gunwale edges (fig. 126, *b*, *c*). The side notches are cut to make the projecting under part narrower than the distance between the gunwale edges. This allows the seat to slide easily along the gunwale and so be adjusted to suit the inclination of the mast. After getting the right position, it is placed obliquely so as to join against the edges of the gunwales and thus lock the mast step. When the mast step is set squarely it is termed *riu tonu*; when set obliquely, *riu hakaharau*. A hole is made in the middle of the upper surface of the mast step, and the lower surface of the mast butt rests against the posterior part when the mast is raised in the forward slanting position. No specific term was obtained for the mast step; it was referred to generally as the *me tuku pou* (thing for supporting the mast). When not supporting the mast, the mast step formed a convenient seat.

TACKING

As the Kapingamarangi canoes have no platform or balance board on the side opposite the outrigger, they are always sailed with the outrigger on the weather side and the sail is always on the lee side of the mast. This is to prevent capsizing, for when the canoe heels over and the outrigger comes out of the water, it can be pressed down by leaning out over it. It is an advantage to sail with the outrigger float out of the water and so lessen friction; but if it comes up too high, the canoe is in danger of turning over on the lee side. If the canoe were sailed with the outrigger on the lee side, similar heeling would oversubmerge the outrigger float to the point of capsizing. There is no means of counteracting this in the absence of a weather platform.

Thus, in tacking, the outrigger must remain on the weather side and the canoe be sailed stern foremost. This makes no difference so far as the hull is concerned, for both bow and stern are pointed. However, as the sail must be shifted, a member of the crew lifts the forked end of the yard and carries it to the appropriate part of the stern when it is forward. The fork is stepped on the gunwale rail. The butt of the mast is also shifted back to what was the true fore main outrigger boom which is now aft in position.

PADDLES

Paddles, which bear the general Polynesian name of *hoe*, are neatly made of *woroworo* wood, but a few that are very light have been made of drift timber. The shafts (*kau*) are comparatively short. They have no knob at the upper end, but a slight flange (*kenu*) is made on each side of the shaft about 10 inches from the junction with the blade. The flange provides a grip for the right hand, and it is considered wrong to hold above or below it. The blade (*raurau*) is fairly narrow, the widest part being on the upper half. The junction with the shaft forms lateral obtuse angles or shoulders from which the side edges slope evenly downward and outward. The tip end expands slightly on either side and is thickened anteriorly and posteriorly to form a distinct knob which is likened to the human nipple (*matariri u*) by being termed *matariri hoe* (paddle nipple). As the blade surfaces are evenly flat, it does not matter which surface is turned to the back in paddling.

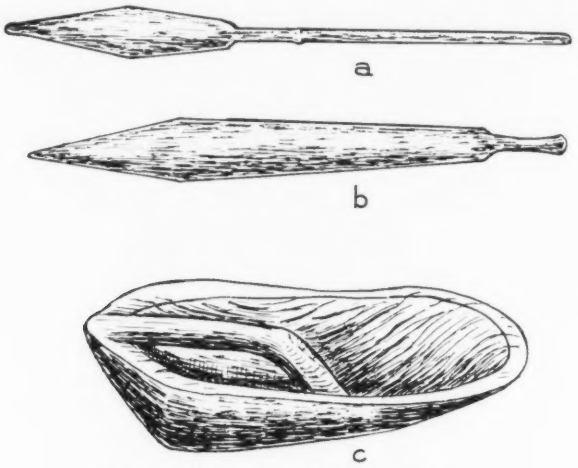

FIGURE 127.—*a*, *b*, paddles; *c*, bailer.

In making a paddle, the finger span of a full stretch between thumb and middle finger, termed *anga*, is used. The handle measurement is given as five *anga*, and the *kenu* flange is one *anga* from the blade junction. The blade length is given as two *anga* and a short *anga*. The short *anga* is the distance from the tip of the thumb to the bent first joint of the forefinger, both widely stretched. The short *anga* is expressed by the term *ti anga te maro*, in which *te* is the negative, hence the meaning is "the *anga* which is not fully stretched." A typical paddle, in Bishop Museum (C.10133), has the following measurements: total length, 66 inches; handle length, 40 inches; blade length, 26 inches; flange from junction, 8 inches; and greatest blade width 5.2 inches. (See figure 127, *a*.)

According to informants, the paddle nipple, which I thought was meant to strengthen the point for pushing off against the coral bottom in shallow water, has a totally different function. When the paddle is used vigorously with a deep stroke, it makes a marked gurgling sound which is said to attract fish and is termed *tongoro*. In ordinary paddling, however, the *tongoro* sound is made to change the monotony of paddling and also to convey the impression that extra effort is being applied to increase speed.

In using the paddle, the right hand grasps the shaft flange (*kenu*) in the ordinary grip, but the left hand is turned back to grasp the upper end of the shaft. This grip is held to be more effective and less fatiguing than the ordinary grip with the left hand. In making a stroke, the left hand pushes the upper end of the shaft forward with the right hand acting as the fulcrum of a lever, and the backward pull of the right hand with the forward push of the left hand assist each other. It is a somewhat awkward grip at first, but its advantage is obvious when one becomes used to it. In dipping the paddle into the water, the shaft is held vertical to make strong deep strokes, but a paddler may slant his paddle to rest after a vigorous bout with deep strokes. Women who take part in paddling to and from the outer islands, use the slanting dip with the lower hand resting on the thigh. Paddlers change sides frequently, not only to help in keeping a straight course, but for the relief of changing hands.

The four ways of paddling, each with a name, follow:

Hakamau: ordinary paddling with a slow easy stroke.

Tahi: a long, vigorous stroke in which the body leans well forward to enable the paddler to stretch forward for a longer stroke. The body and head come up to an erect position at the end of the stroke. The body, head, and paddle movements blend into an automatic rhythm in which all share to promote more rapid progress.

Hakamihi: short, quick strokes with the blades not dipping so deeply.

Hangai: double quick time in spurting. The paddlers do not dip so deeply and they purposely send up spray at the end of the strokes. In a canoe race, the yell of *hangai* by the bow paddler results in the whole crew keeping perfect time to the fast stroke and sending up a flurry of spray along the whole length of the canoe on both sides.

Steering paddles are termed *hoe uru, hoe urungi*, from *urungi*, to steer. They have longer and wider blades, but the handles are usually shorter in proportion and have a knob at the upper end. In some, the lower part of the shaft is thicker than the upper part and sometimes there is a distinct shoulder at the meeting of the two. In one paddle examined, the lower part was 6 inches in circumference and the upper part, 4 inches. The tip end of the blade does not have the nipple point. Steering paddles are highly valued because the width takes extra wood and suitable wood is getting scarce. In fact, we had trouble in getting the specimen (C.10130) shown in figure 127, *b*. It has the following dimensions: total length, 50.25 inches; handle length, 8.5 inches; blade length, 41.75 inches; and blade width, 5.5 inches.

Some lighter paddles without the nipple point were seen in use, but they proved to be the usual paddles, having been reshaped after the knobbed points were broken off against coral.

Nukuoro paddles are similar in general shape, but with thicker shafts. The blades join the shaft at a continuous slant without shoulders, and there is no tip enlargement of the blade.

CANOE POLES

Poles (*toko*), part of the usual equipment of a canoe, rest on the forked false boom and the main booms. The best wood is *woroworo*, but other woods of convenient size, about 10 or more feet long and an inch or more thick, are used. It is easier and quicker to pole than to paddle. In traveling to the other islands, poling is used along the shallow parts inshore.

BAILERS

Bailers (*ta*) of native manufacture are carried in every canoe. Fortunately, the degenerate stage of using empty cans or half coconut shells had not been reached when we were there. The bailers are somewhat narrow, to suit the narrow bilge of the canoe hulls, but follow the general Polynesian pattern of a wooden scoop with a handle (*kau ta*) projecting forward from the back end. The back is obtusely V-shaped, and the handle differs from the usual Polynesian technique in that the forward end is bent down at an obtuse angle to join with the bottom. The reason given for the downward junction to the bottom was that the breadfruit wood of which they are made is somewhat brittle and that children might tread on the handle when the bailer rests in the bottom of the canoe.

The dimensions of the typical bailer (C.10002) shown in figure 127, *c* are as follow: length, 13.75 inches; width, 5.5 inches; depth outside, 3.5 inches; depth inside, 2.9 inches; and handle diameter, 1 inch.

CANOE SUPPORTS

Within the canoe sheds, the canoes are raised off the ground, and wooden supports termed *ranga* are placed beneath the hull. They are usually formed of a portion of trunk with three or four branches cut level to form legs. The upper end is slightly hollowed to support the keel, and two supports are sufficient. The phrase used is *tokoria i ti kerekere* (propped up clear of the ground). The outrigger float is supported by a rope passed around it and some part of the house framework.

On landing at one of the islands, a canoe pole (*toko*) is usually laid transversely near the water's edge, and the bow of the canoe drawn up over it.

FISHING

INTRODUCTION

Fishing is Kapingamarangi's most important activity, as it procures the main source of protein food. It is conducted entirely by men, who, as the women are responsible for the care of the *puraka* and taro cultivations, have time to devote to catching fish and to preparing necessary gear.

The chief means of catching fish are nets, hooks and line, and traps. Before trade contacts, much time must have been expended in preparing breadfruit, hau, and *warenga* bast and twisting the cord to make the various forms of nets and the long lines for deep-sea fishing. The manufacture of hooks from marine shells and coconut shell also involved a fair amount of time. Among the benefits introduced by foreign trade are linen cord, fishing lines, and metal hooks, all labor saving. However, the methods of using the new materials continue to follow old, established processes. Fish traps are still made on the old patterns with no changes beyond the occasional introduction from Nukuoro and Ponape of wood suitable for splitting into the laths and rods for the manufacture of the trap. Two-ply coir cord continues to be the material for making one form of net and for lashing parts of the trap together.

A number of subsidiary methods were formerly employed, but fish spears and bows and arrows, though described, are things of the past. The dilapidated condition of the fish weirs indicates that they are now used rarely, if ever.

NETS

Introduction

Fishing nets are in common use, particularly hand nets for catching small fish to serve as bait for line fishing outside the reef. Long seine nets are not made, but shorter lengths are joined together temporarily to form the arms of a V-shaped race leading to a trap. Hand nets are used individually, but the V-shaped race requires a community effort with a number of men to set the nets, place the trap, and drive fish into the race.

Nets were formerly made of two-ply cord prepared from the bast of the *warenga* and breadfruit trees, but now, commercial twine has replaced these materials, though nets made of breadfruit bast are occasionally seen. The nets that form the V-shaped race are still made of coir fiber, which is better suited to this form of fishing.

For hand nets made of the softer breadfruit bast or imported twine, the Polynesian type of netting needle is still used; but some fishermen have adopted the European form of needle. Mesh gauges are used. For making nets of coir cord, a loop method is used instead of a netting needle.

The mesh knot is the same as that used throughout Polynesia, and the same form of knot is utilized in making the coir nets. Coir nets have floats, and a local peculiarity is that they are placed very close together on the top line of the net so that they practically form a continuous line. Nets with floats have no permanent sinkers attached to the bottom line, another local peculiarity.

Nets bear the general Polynesian name of *kupenga*, and the meshes are termed *mata*. If the net is made with a netting needle (*hika*), the name of the instrument is also applied to the process of making the net, as *hika ti kupenga* (make the net). In making coir nets with a cluster of loops instead of a needle, the term *tata* is used as in *tata ti kupenga kau* (make the coir net).

Netting Implements

The netting needle is termed *hika*, the name applied to the shuttle used in weaving. Its shape and the method of applying the cord are identical, but the netting needle is much smaller. For a fine-meshed net, such as the *tae tauwene* hand net, they are particularly small. One seen in use was 8.5 inches long, 0.25 inch wide, and 0.15 inch thick. The needles are made of *matira* (bamboo) or of *woroworo* (*Premna integrifolia*) wood.

The mesh gauges (*papa*) are made of *woroworo*. They are flat, thin lengths of wood and are made in widths corresponding to the size of mesh required. The small gauge used in making the *tae tauwene* net is 8 inches long, 0.2 inch wide, and 0.1 inch thick. It is made of a dark, foreign wood which is highly polished.

Net Commencement

To make the commencement row, a complementary cord is used to form the upper halves of the meshes, and the lower halves are made with the cord from the netting needle. A thick cord is first stretched between two uprights to give support to the first row of meshes. If the netter has no assistant, he winds the supplementary cord in spiral turns around the supporting cord and proceeds as shown in figure 128, *a*. The more general practice, however, is for an assistant to hold the complementary cord to keep the upper loops taut while the netter uses the netting needle, as shown in figure 128, *b*, *c*. The process illustrated is described below.

In *a*, the supporting cord (1) is stretched between the uprights and the complementary cord (2) is wound spirally around it. The netting cord (3) from the netting needle is tied to the supplementary cord on the left, and the mesh gauge (4) is placed in position. The netting cord descends on the far side of the gauge, passes upward on the near side and makes the netting knot with the near turns of the supplementary cord at the upper edge of the gauge. As shown in *b*, after knotting the left ends of the complementary cord (2) and the netting cord (3) together, the assistant forms the upper part of the mesh by bringing down the supplementary cord on the back of the supporting cord (1), forming a loop, and passing the cord upward over the near side of the supporting

cord. He slackens or tautens the cord as directed by the netter, who then makes the netting knot over the loop, as in *a*. This continues throughout the commencement row, and after the last netting knot on the right, the supplementary cord is cut off and the services of the assistant ended. In *c*, is shown an enlargement of the netting knot as it is made on the near side of the mesh.

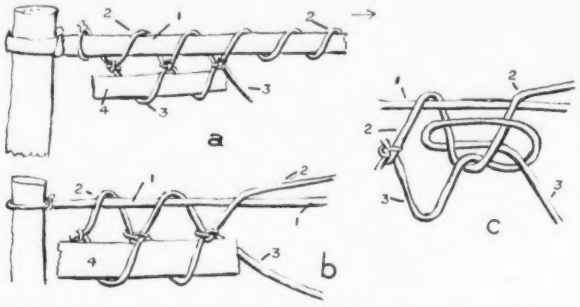

FIGURE 128.—*a*, *b*, commencement of netting technique; *c*, netting knot.

The second row is made with the meshes of the commencement row for the whole width, and succeeding rows are added until the length of the net is reached.

HAND NETS

Hand nets are made in three forms with the following names: *kupenga hurihuri*, *tae tauwene*, *tae tawe*. The first derived its name from the manner in which it was used and the other two from the *tauwene* and *tawe* fishes which were caught in them. The three nets are made of twine other than coir cord and with the netting needle.

KUPENGA HURIHURI NET

The *kupenga hurihuri* (*kupenga*, net; *hurihuri*, to turn things over) derives its name from being used near rocks which an assistant turns over (*hurihuri*) to drive out the fish lurking between them. As the fish dart out, they are deftly scooped up in the net.

The net is in the form of a shallow bag attached on one side to a curved rod and on the other to a cord stretched taut between the ends of the rod. In the type net examined, the curved rod of hau was 7 feet 5 inches long, 1.2 inches in diameter at the thick end, and 0.8 inch at the other end. A few inches from the thick end, a 4 inch-long, short natural branch on the outer convex side, formed a handle (*kau*).

A circumferential cord was threaded through the marginal meshes of one side of the bag net and the cord, when tied to the two ends of the rod,

formed a stretch of 6 feet 2 inches. The cord was tied with clove hitches, and the two ends, which were long, continued the threading through the marginal edges of the other edge of the net. Working from the far end of the rod, the cord, after passing through the marginal meshes for a few inches, made two half-hitches around the rod and continued in this way until it reached the short handle. A similar process was carried out with the other end of the cord from the near end of the rod until it also reached the handle. The two end cords were brought together as a double cord, made a turn around the rod, and then around the base of the handle to make a hitch around the cord where it left the net to pass around the rod. The double cord was then tied with an overhand knot around the part which made a loop around the handle. The upper edge of the bag net was thus secured to the taut cord and the rod frame for its entire circumference. In the model made for the Museum (C.10000), the net margin is not attached continuously to the rod frame, but a short gap is left in the middle which is bridged by the cord being drawn taut (fig. 129).

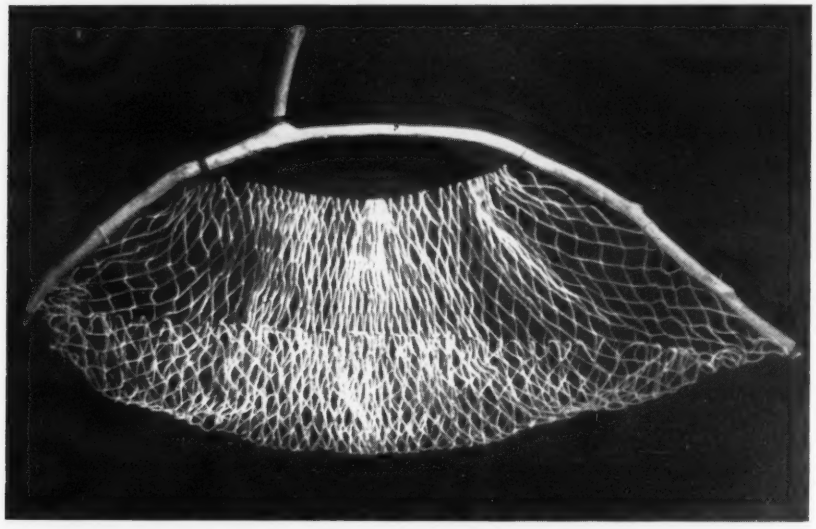

FIGURE 129.—*Kupinga hurihuri* hand net.

The length of the bag in the type net coincided with the 6 feet 2 inches of the stretched cord, the width in the middle between the taut handle and the curved rod was 19 inches, and the depth of the bag, 24 inches.

In use, the net is held by the thick end of the rod with the left hand and the right hand holds the short handle. The rocks where the net is used are near the outer reef.

The correct name for the net is *ti kupenga hurihuri*, but *kupenga* is now left out and it is called *ti hurihuri*. In ordinary speech, the definite article *ti* has become fused with the noun and the name generally used has become *turihuri*.

TAE TAUWENE NET

The *tae tauwene* is a scoop net which is much used by fishermen to catch the small *tauwene* fish used as bait for off-reef fishing. It has a somewhat complicated frame consisting of five different wooden parts. First a hoop (*tihia*) is formed of a branch which has another branch at a right angle to serve as a handle (*kau*). The rim branch is long on one side of the handle and short on the other (fig. 130, *a*), with the long end bent around to meet the short end and the junction lashed in a slant join (*hukuinga*). The opening formed by the hoop is termed *matatae*. Two upright rods (*turuturu*) are erected in the middle of each side of the hoop, a notch being cut in the hoop to receive the trimmed lower ends of the rods. The rods are fastened to the hoop with the typical *hau ni hou* lashing shown and described in figure 85.

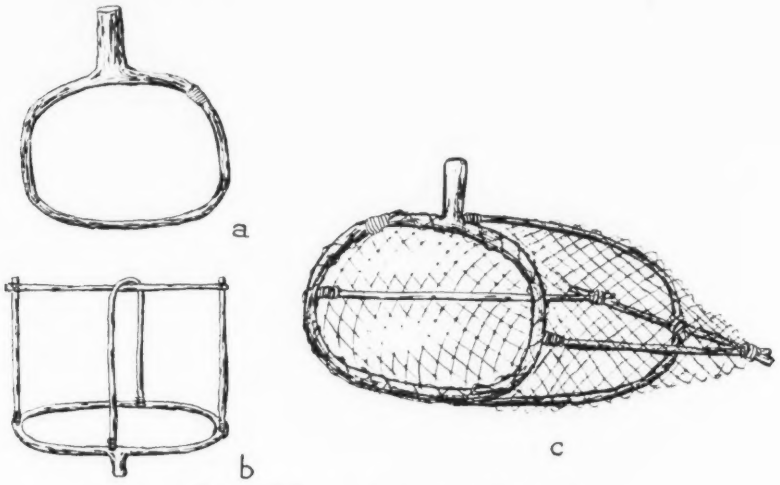

FIGURE 130.—*a-c*, *tae tauwene*, hand net.

With the hoop flat on the ground, a cross bar termed *tahuhu* (ridgepole) is lashed to the upper ends of the two uprights. An arched rod (*rakau hakapika*: *rakau*, rod; *hakapika*, bent) is crossed over the middle of the ridgepole at right angles, and the two lower ends are fixed to the hoop in the same way as the uprights. The arched rod is tied above to the ridgepole (fig. 130, *b*). The framework now complete, a bag net with a fine mesh is fitted over it and tied below to the circumference of the hoop (fig. 130, *c*). Through an oversight, the exact measurements of this type of net were not taken.

There are three methods of using the net: (1) It is used near submerged rocks in the lagoon by a single individual. When the small schools of *tauwene* are seen, the fisherman, holding the net by the short handle, approaches the net cautiously toward them and scoops (*ahu*) them up. Sometimes he is able to direct the fish into the net with his foot. (2) Another method is to feed the fish with Tridacna (*pahua*). A wooden wedge termed *tina* is inserted in the circular gap by the hinge of the shell and twisted to cut the muscles and thus open the shell. The flesh is scraped out (*kape*) and used as ground bait to attract the *tauwene* fish. (3) It is also used with fish weirs. The fisherman places his net across the opening at the apex of the inclined walls and others drive fish into the race formed by the walls. This method is not used for *tauwene* alone, but for any fish that might be driven in.

FLYING-FISH NET

The *tae tawe* net is used for catching flying fish (*tawe*) both for eating and for bait, the term *tae* indicating a net with a hoop opening. It is formed of a bag net attached to a hoop frame, which is fastened to a long handle.

The handle (*kau tae*) in the type specimen (C.8526) is a light hau pole, 7 feet 2 inches long, and 1 inch in diameter at the thickest part toward the hoop end. The thicker distal end has an upward curve in its last 9 inches of length, and the end is scraped down to a diameter of 0.6 inch. A cross bar (*manu*), 8.7 inches long and 0.4 inch thick, is lashed to the under side of the distal end of the handle with fine coir cord forming the chevron pattern.

The hoop frame (*toko tae*) is formed of two branches of *takahara* wood. The proximal ends of the branches are cut to a slant and applied to each side of the handle, 10 inches from its end, and lashed to it in the manner shown in figure 131, *a-f* and described as follows:

In *a*, the knotted end of a coil of fine coir cord is laid on the front of the handle (1) below the lower junction of the left limb (2), and the cord makes an oblique turn upward to the right to pass through the upper angle with the right limb (3), passes around it and over itself, and descends obliquely on the back to the left where it appears below the left limb (2).

In *b*, the cord crosses transversely over the front of the handle and the knotted end to fix the commencement. On the right, it passes around the lower part of the right limb (3) to the back, where it ascends obliquely to the left and passes through the upper angle of the left limb (2).

In *c*, the cord makes a backward turn around the left limb, reappears in the front of the upper left angle, and descends obliquely to the right, crosses the first oblique turn, and reaches the lower side of the right limb above the first transverse turn.

In *d*, the cord makes a transverse turn from the right across the back and reappears on the left on the lower side of the left limb and above the front transverse turn. It is now in position to continue as in *a*.

In *e*, the rest of the technique is continued repetition of the movements from *a* to *d* in which the lower transverse turns, both back and front, the oblique turns back and front, and the turns around the two limbs are made above the preceding ones. In this way, the two limbs are securely lashed to the handle and the decorative pattern shown in *f* is developed.

The two limbs of the hoop are lashed to the under side of the ends of the cross bar with crossed diagonal turns. The limbs have an upward curve; but at 4 inches from the cross bar, they form marked obtuse angles with the forward parts, which now slope downward. It is apparent that this curious angle is a natural formation of two separate branches with the stem which connected them cut away. The limbs are thickest at the angle, where they are 0.5 inch thick; at the proximal and distal ends they diminish to 0.35 inch thick (fig. 132, *a*).

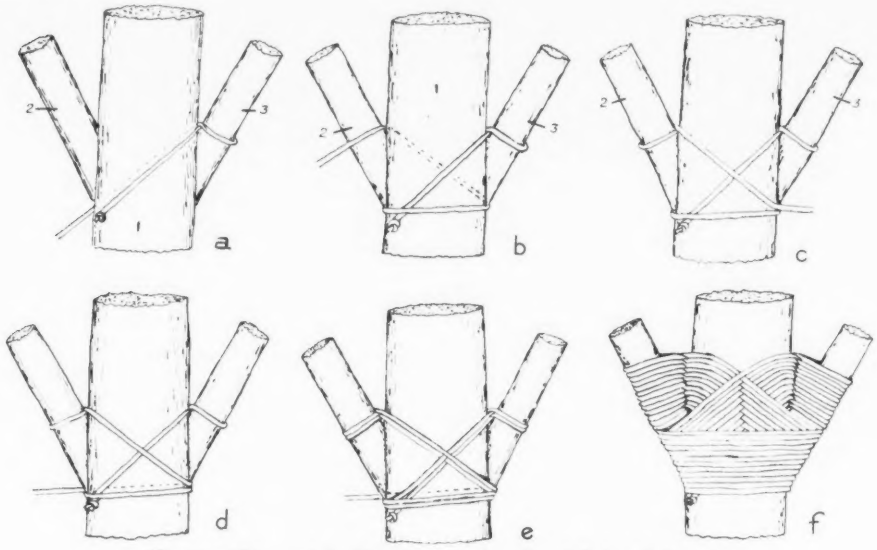

FIGURE 131.—*a-f*, lashing hoop to handle of flying-fish net.

One of the two limbs is longer than the other, the longer one curved around to form the distal end of the hoop. It joins the shorter limb, in a long slanted join (*hukuinga*) lashed with close transverse turns. This completes the whole frame, termed *ti ta* (the *ta*). The length in the middle line from the cross bar is 13 inches and the greatest width at the side angles, 9.8 inches.

The bag net (*kana*) is attached to the hoop by a cord which commences on one side 2 inches behind the cross bar and is carried in spiral turns around the hoop and through the marginal meshes in a course completely around the hoop to a point on the other limb opposite the commencement. The cord is then returned in the opposite direction with similar spiral turns which cross over the first turns made through the meshes (fig. 132, *b*).

A transverse cord termed the *takihana* is tied at the commencement of the spiral turns, threaded through the remaining marginal meshes, and tied at a similar point on the other arm of the hoop (fig. 132, *c*).

In dealing with the dimensions of the bag net, which is made of fine coir cord, the length and breadth is indicated by the number of meshes. The measurement of one side of the hoop is termed the *taringa,* which in a net examined was 23 meshes, while the depth termed *tata* is 18 meshes. In the type net, the length from the cross cord to the distal end is 15 inches and the greatest depth 11 inches.

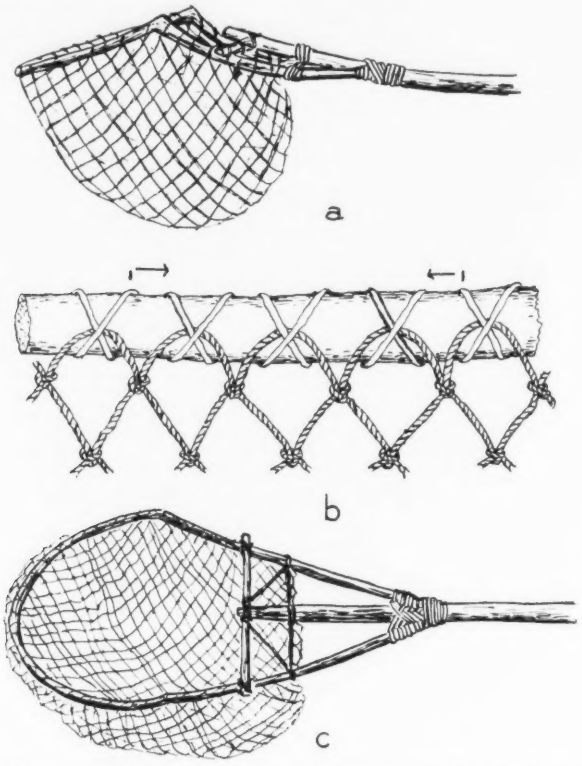

FIGURE 132.—Flying-fish net: *a, c,* completed; *b,* attachment of net to hoop.

Netting Flying Fish

The method of using the flying-fish net involves so many accessories and details that a detailed discussion seems appropriate here.

One accessory, the fisherman's stand (fig. 133), was used only with the flying-fish net at night and only on the Kapingamarangi type of canoe, which has been replaced by the Nukuoro canoe. The narrow hold openings of the Nukuoro canoes do not require special stands and so the fisherman's stand has passed out of use with the Kapingamarangi canoe for which it was designed.

As the wider hole opening of the Kapingamarangi canoe gave insufficient support to the legs of a flying fish netter, the fisherman's stand (*tahiia*) was devised to prevent overbalancing when making long thrusts with the net. It was a wooden frame for lashing over the fore part of the canoe hold to add height and reduce width and was formed of two side pieces which were dubbed into boards 1 inch thick at the fore end and 1.4 inches at the aft end. They were kept at the correct distance apart by two wooden struts and two cord stays. The fore limbs were lashed to the forward connecting rod between the fore ends of the gunwale rails and the aft limbs were lashed to the inboard part of the convenient false boom. The fisherman stood in front of the main partition where the increase in depth was 2.5 inches from the upward curve of the lower edge and 4.5 inches from the side pieces, making 7 inches in all. With the increase in depth and the reduction in width to 5.75 inches, the stand provided the necessary support. A full-sized stand in Bishop Museum (C.10145) is shown in figure 133 and described below.

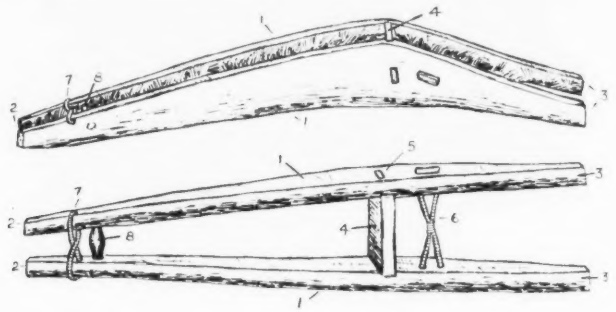

FIGURE 133.—Fisherman's stand.

In the side view, the side pieces (1), set on edge, are shaped to form long fore arms (2), shorter after arms (3), and an intermediate raised part to obtain the required depth. They are 50 inches long with an upward curve on the lower edge, which rises 2.5 inches above the horizontal. The highest part is at the junction of the middle and posterior thirds where the wooden part is 4.5 inches in depth. From this deepest part, the upper borders which are rounded off on the inner edges, slope down toward the ends. The fore ends (2) are 1 inch thick vertically and the aft ends (3), 1.75 inches. Below the highest part, a rectangular slot (5) is cut through for the tongue of a wooden partition or strut (4), and rectangular grooves are cut vertically on the inner surfaces to fit the ends of the partition (4). Aft of the partition, two holes (6) are bored through each side for the aft braces, the part between on the outer surface being grooved so that the subsequent lashing turns are sunk below the surface. Single holes are bored through each fore arm, 4.5 inches from the end, for the fore brace (7); and 1.5 inches farther back, a sunken hole on each side is made for a short wooden prop (8).

The view from above shows that the side pieces (1) are not parallel; the inner width between at the fore end being 2 inches; at the partition, 5.75 inches; and at the aft ends, 7 inches. The partition (4) is 5.75 inches wide with an extra 0.25 inch at each end let into the vertical grooves on the inner surfaces of the side pieces and with a rectangular tongue on each side set in the side slots (5). It is the same depth as the side

pieces, 4.5 inches. A rounded peg (8) about an inch in diameter, is fitted into the sunken pits at the fore end. The aft brace (6) consists of a number of parallel rounds of two-ply, left-hand cord passing through the paired holes on each side, then seized, and the middle parts drawn together by four turns of the cord passed around them. The fore brace (7) consists of figure-of-eight turns passing between the forward holes and over the upper edge of the fore limbs, the turns being finally seized.

We went on a fishing expedition the purpose of which was to view the method of line fishing for tuna, but flying fish had to be procured for bait beforehand. Our party embarked in two canoes from Touhou in the late afternoon, intending to sleep at the small islet of Motukerekere near the main channel in the reef. We called on the way at the island of Tirakaume to get a supply of drinking nuts and some dry coconut leaves for torches. This was necessary, as Motukerekere, though it had a thatched house for a fishermen's resting place, was very small and had but one coconut tree growing on it.

The torches were made of single, dry coconut leaves, the leaflets being folded and tied at intervals with five bands of dry coconut leaflets to make a compact torch. Several torches were quickly made and placed between the two halves of a *hinai* mat, which was laid on the outrigger platform. The crew of our outrigger canoe consisted of three experts and two observers. After supper at Motukerekere, we paddled across the lagoon to a far channel in the reef through which we passed into the open sea.

We went out to about 300 or 400 yards beyond the reef and then turned to paddle along parallel with it. One of the crew picked up the *tae tawe* net and stood up in the bow, where the two sides of the gunwale were only 7 inches apart and gave ample support to the legs of a fisherman.

The man next to the netter, as I will call the one handling the net, pulled a torch out of the folder and handed it to him. The netter lighted the tip end of the torch and waved it about to make it burn more brightly. Then with the torch in his left hand and the handle of the net in his right hand, he peered ahead and from side to side while the others kept on paddling.

It may be well to state here that flying fish are not caught in the air like butterflies. Rather, they are seen in the water, and the netter plunges his net into the water to intercept them. The act of thrusting with the net is termed *purou*, a compound of *rou*.

The netter made several unsuccessful thrusts on either side, and we were beginning to doubt his skill when he caught two flying fish with one thrust. He swung the net back and banged it against the inner side of the hull gunwale to empty out the fish. As the bangings became more frequent, I wondered at the strength of the net frame and also at the perfect timing of the netter, for he did not look back as he emptied the catch into the hold. Though the handle of the net is long, the netter held it fairly short for balance. Now and again

he slid it along to make a long thrust. He was equally expert on either side of the canoe with forehand and backhand thrusts. Every now and then he struck the torch against the lifting stringer on the left or against the net handle on the right to get rid of the burnt out ends of the leaflets which fell off in a shower of sparks. As the torch burned down, he pulled down the tie band nearest to the flame. When the torch was burnt out, all the tie bands were at its lower end. There was a fairly constant flow of sparks from the torch and, as the netter frequently held it above his head to get a clearer view, one realized the need for the fisherman's conical hat and why it has the name of *kopai waka rama* (hat for use in a canoe when torching). The torch was held well out on either side to get a longer field of light, hence the sparks fell into the sea. But, when, to get a forward view, the torch was held above the head, the hat prevented the sparks from falling into the hair.

The man who was steering the canoe wore the orthodox conical pandanus hat, whereas the netter was wearing an ordinary felt hat. The coxswain ventured so much advice when the netter made an unsuccessful thrust that the netter asked him to take the net. When he took up his position with the torch and net and the conical cap, he certainly looked his part, and we anticipated a more expert demonstration with the net. He proved to be all fisherman with his gaze so concentrated on searching the waters that he had little thought left for the crew or his guests. Rightly enough, he held the torch where it suited him. When he snuffed the torch against the net handle, he did it rather close in with the result that a shower of blazing sparks was wafted aboard the canoe. Even the crew members expostulated at times at their attention being diverted from paddling. However, an occasional thud against the gunwales showed that a certain amount of success followed the sparks, and we forgave the wearer of the conical hat for the temporary inconvenience. However, he made as many misses as the first operator. This was due in both cases to a kind of reflex action which caused them to make vain thrusts at any fish they saw. The small spread of the net opening, the speed of the fish and the canoe, and the refraction of the water, all required expert judgment in guiding the thrust to the right place to intercept the fish.

When the torch burned down, the forward crewman extracted another from the holder and handed it to the netter. The netter lit the end of the fresh torch from the stump of the old one, which he cast overboard. It was quite extraordinary the length of time one torch lasted, and I regretted that I did not carry a watch to time it. We paddled a considerable distance parallel with the reef and passed the main channel, Motukerekere, and some other islands. We turned back on our course and saw some large ulua swimming below the canoe. These excited the interest of our crew, and after some discussion, the canoe was turned in toward the reef opposite our camp on

Motukerekere. The first netter picked up a canoe pole, and when we were just outside of the breaking of the waves against the reef, he quietly slipped overboard, passed through the waves, and landed on the reef. I thought at first that he had left because of disagreement with the man with the conical hat. However, the canoe waited off the reef, and in a short time the absentee appeared on the reef, passed through the waves, and came aboard with a fishing line. It was quickly baited with a piece of flying fish and, whilst the conical hat fisherman still continued torching, his predecessor dropped the line over and trolled for bigger fish. However, the large fish had disappeared and we had no luck with the line. By this time we were opposite the main channel, so we turned in and paddled back to Motukerekere for a night's rest before engaging in tuna fishing. Our crew were not satisfied with our catch of flying fish, for they went out again while we were sound asleep and caught more flying fish to furnish a sufficient supply of bait for the next day.

Purse Net

A purse net, formerly termed *takitaki* and now called *pukene*, is made of two-ply cord of breadfruit bast, 2 mm. thick, and with an inch mesh. The net examined had been made to a length of 11 feet 6 inches and a depth of 6 feet 5 inches. It was doubled over to half its length with the two ends to the left. Commencing with what was to be the bottom, a thick breadfruit cord was tied at the right, folded end and threaded through the marginal meshes of both sides to close the bottom. On the left side, the cord was continued through the marginal meshes of both ends, hence a closed bag was formed 5 feet 9 inches wide and 6 feet 5 inches deep. The open end was termed the *pu*. Five or six floats of breadfruit wood, threaded on a cord, were attached to what was to form the upper edge of the opening. Two cords were attached to what was to be the lower edge of the opening and these were for attachment to a straight net on either side which were to form the commencement of wings leading to the purse, or bag (fig. 134, *a*).

This net is set in the same way as the *u hakapakipaki* trap, the netted purse taking the place of the trap. The first two nets are attached to either side of the purse net by a cord threaded through the marginal meshes of each, the floats of the purse net above. The two coir nets have their lower edges brought together and tied for a few inches. The lines of the race on either side are usually the coir nets termed the *kau*, but they are also referred to as *kupenga horohoro*, the explanation given being that *horohoro* refers to the men who surround the nets as the fish are driven into the race. The term *kupenga horohoro* also seems to refer to this form of fishing when a *pokene* purse net is used, and the term serves to distinguish it from the *u hakapakipaki* process when a trap is used.

On inquiring as to whether coconut-leaf sweeps were used as they were in Polynesia, I was told that they were used in connection with the *pukene* purse net. The following statement was made: "Ti hari ku pini ki rou niu hai ti kupenga." (The rope was wound round with coconut leaves to make the net.) The leaf midribs were split for winding around the rope, and the rope thus treated was called a *kupenga rou niu* (coconut-leaf net). These were used instead of the coir nets to form the two arms of the race leading to the purse net.

FIGURE 134.—*a*, purse net; *b*, throw net (Lathrop photographs).

THROW NET

A throw net termed *kupenga hutuhutu* is said to have been introduced in recent times from Ponape, where it is said to have been introduced by the Japanese. The net gets the local name of *hutuhutu* from the verb *hutu*, to cast or throw. (The act of throwing up thatch sheets to the thatchers on the roof of a house is *hutu*.)

Two throw nets were seen hanging up to dry at Werua. One was 18 feet from the center to the cord which passed around the circumference of the net. The circumferential cord was weighted with lead sinkers, which confirmed the modern origin of the net (fig. 134, *b*).

COIR NETS

Coir nets, referred to as *ti kau kupenga*, are made of two-ply, right-hand twist cord (*tirahira*) in lengths of 24 feet 5 inches with a depth of 7 feet 8 inches. A top cord and a lashing cord carry the closely set floats, and

a bottom rope is attached to the lower margin. There are no permanent sinkers attached to it (fig. 135, *a*, *b*).

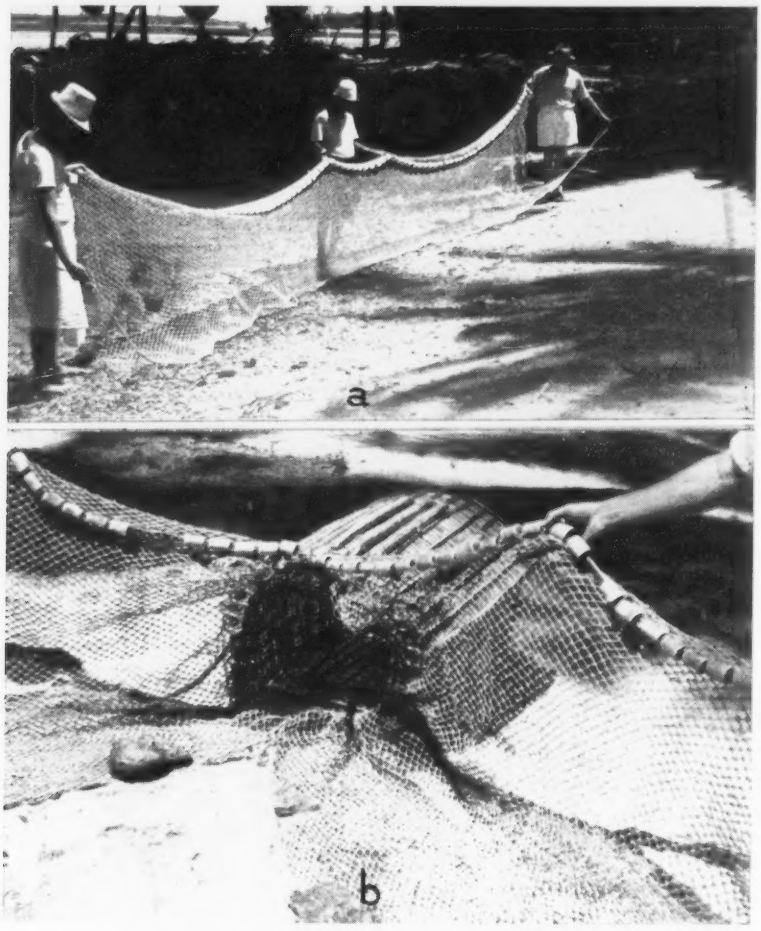

FIGURE 135.—Coir nets: *a*, complete net section; *b*, attachment to trap (Lathrop photographs).

The above general description was obtained from the nets in a canoe house, but when King David demonstrated the full process in making a small pair of nets for Bishop Museum, a new field of technical details was revealed. First, he stretched a cord between two fixed uprights and an assistant stood by with a length of coir cord to assist in setting up the first row of meshes, which was to set the width or depth of the net. He had a mesh gauge, but the orthodox netting needle was absent. David smiled at my

puzzled expression and, picking up a workman's coil of coir cord, explained that a netting needle loaded with a sufficient length of coir cord would be too bulky to pass through the meshes. Therefore, a series of long loops was hitched to a standing loop by means of which a sufficient length of cord could be drawn through the meshes. The loop technique is described below and shown in figure 136, *a-e*.

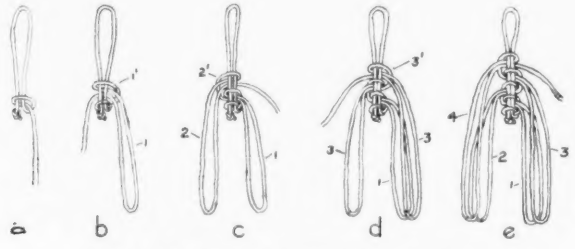

FIGURE 136.—*a-e*, netting loop cluster.

In *a*, the free end of a coil is knotted and a running noose made around the standing part to form a standing loop, or the knot and the end of the loop are held together while the coil makes a hitch around the two. In *b*, the coil is crossed over to the left making a short loop (1′) on the right. A loop of the coil is then passed under the standing loop and through the short loop (1′) to form the long loop (1) on the right. In *c*, the coil is crossed over to the right making a short loop (2′) on the left. A second long loop (2) is passed under the standing loop and through the short loop (2′), which is drawn taut. The coil is on the right. In *d*, the coil is crossed over to the left to make a short loop (3′) on the right. A third long loop (3) is passed under the standing loop and through the short loop (3′) to form a second loop (3) on the right. A second loop (*e*, 4) is made on the left in the same way as the second loop in *c*.

Thus long loops are made alternately on the right and left until the cluster of loops contains a good length of cord and yet is not too large to pass through the netting meshes. Should the loop cluster be too large, it is a simple matter to pull out one or more loops to reduce the size of the cluster.

If the coil is not used up, it is cut off and the free end of the loop cluster is tied to the end of the commencement cord held by the assistant. The setting up of the first row of meshes is exactly the same as with the other nets (fig. 128), except that instead of the netting needle, the standing loop of the loop cluster is passed through the mesh loop and the loop cluster pulled through. In the full-sized net, the first row is continued until the width reaches the required measure of 7 feet 8 inches to form the depth of the net which will form one end (*matarima*). In the sampler made by King David, the width is less, but the cord (3 mm. thick) and the mesh (1.6 inches) are the normal size. After the end row is completed, the supplementary cord held by the assistant is cut off and his services ended. A second row is added to the first and successive rows are continued until the length is obtained. When

the cord from the loop cluster gets short, the top loop is released by pulling on the cord. In closing the netting knots, the right thumb is hooked under the cord, which is drawn taut by pulling with it. King David, as he drew the cord back with his thumb, called my attention to it and said it was very important. He did not explain why, but it is the established way.

The length of the net having been reached, the next process is the addition of the floats to the upper edge of the net when stretched lengthwise. The floats (*utongi*) are made of short sections of young breadfruit tree or branches, 2.5 to 2.75 inches long and 1.5 to 1.75 inches thick, in which the pith canal of each section is bored through with a pointed stick. Breadfruit is very suitable because it is light and the readily made holes enable the two attachment cords to be passed through them. However, to facilitate the passing of the cords through the float holes, each of them is provided with a needle of green coconut leaflet midrib which is attached to one end of the cord, as follows and as shown in figure 137, *a-c*.

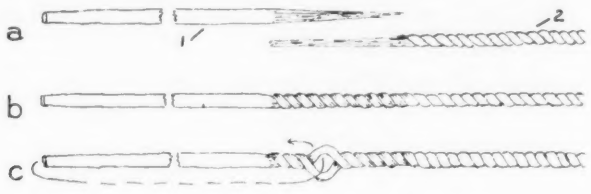

FIGURE 137.—*a-c*, coconut-leaflet needle.

The end of a leaflet midrib (*a*, 1) is frayed out into fibers and the end of the cord (2) is unraveled and fibers broken off to make a thinner ply to blend with the midrib fibers, and the two ends are placed parallel on the right thigh. In *b*, the two fibers are rolled separately on the thigh with the downward motion and then twisted into a two-ply cord on the upward motion, as in making two-ply coir cord. In *c*, the two fibers of the coir cord are separated a little way back from the junction with the midrib and the free end of the midrib is run through the gap and drawn taut. The midrib needle is thus firmly joined to the coir cord.

A midrib needle 10 inches long is attached to each of the two cords. One cord is threaded through a number of floats and laid along the upper edge of the net, the first float being against the left end. The end mesh is drawn against the threaded cord on the left side of the float and the other cord which is the tying cord ties the meshes to the threaded cord as follows (fig. 138, *a-c*):

On the left side of the float, the tying cord (*a*, 1) makes an overhand knot around the threaded cord (2) and the mesh (3). The tying cord passes through the float hole; and on the right side of the float, it makes an overhand knot around the threaded cord and another mesh which is placed against it. The overhand knot is made by the tying cord first passing over the threaded cord and mesh. In *b*, the first overhand knot is drawn taut and a second overhand knot is made with the tying cord around the threaded cord and the mesh; but for this knot, the tying cord (1) first passes under the threaded

cord (2) and the mesh (3). The tying cord then passes through the float hole. In the figure, the second knot has not been drawn taut in order that its direction under may be seen. In *c*, the next float on the right is pushed up close to the double knot, and the technique shown in *b* is repeated between the succeeding floats.

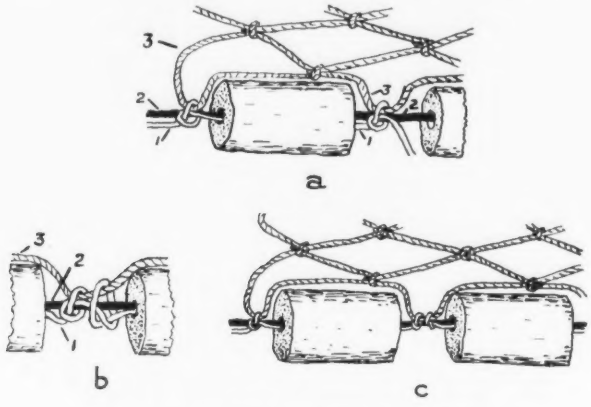

FIGURE 138.—*a-c*, net float attachment.

By the above technique, the floats are attached along the full length of the net, the space between them being little more than that required for tying the two knots. According to King David it was important to reverse the direction of the two knots to prevent the floats from slipping around.

A three-ply rope (*hari*), 8 mm. thick, is attached to the bottom of the net with a chain knot of two overhand knots which are reversed, as in tying the floats. The bottom rope is termed *ti kororo kau* or *ti atu mata kau*.

Coir nets are used in connection with the *u hakapakipaki* trap (fig. 135, *b*), and the *pukeue* purse net. Two methods are employed, driving and waiting, and we were so fortunate as to see both.

FISH DRIVE

The fish drive (*hakapakipaki*) with the net trap and the leading nets of coir cord is a community effort. We left Touhou in the early morning in two canoes. The large canoe from the Touhou men's house had a crew of 10 men who were to be the beaters. A smaller canoe carried King David, Alfred Patterson, and three others, with the trap and the nets. They were the experts to set the trap in the right location and handle the nets. The tide was going out.

The first setting was off Touhou in the shallow waters of the lagoon. The trap was faced parallel with the shore and heavy coral blocks from the floor of the lagoon were placed on the battens of the roof to keep it down on the bottom. A coir net was already tied to each side of the front wall

and overlapped along the projecting porch. These two nets were diverged at their outer ends to form the commencement of a V-shaped race. Other nets were unloaded from the canoe and joined to the first two to lengthen the arms of the race. The inner arm on the shore side was short, the outer arm longer. As succeeding nets were added to the lengthening lines, some men tied the ends together and others weighted down the lower edge with large pieces of coral picked up from the lagoon bottom.

The nets were deep enough to allow for an overlap on the bottom and it was on this overlap, on the inside of the bottom rope, that the stones were laid. As the two lines of nets were being set, the large canoe swept round to a little distance in front of the end opening of the race. The crew jumped overboard with poles and paddles, quickly formed an arc, and advanced toward the race opening beating the water with their poles and paddles. The end men moved quickly to overlap the ends of the race and the drive continued into the race. Excitement was evinced by shouts and yells as fish were seen moving toward the trap. King David sat behind the trap with the water up to his shoulders, for it was his duty to see that there were no gaps in the fastening of the nets to the trap whereby the fish could escape. The drive over, individual nets were quickly untied, folded, and loaded onto the carrying canoes. The stones on the roof of the trap were rolled off by tilting it, and the trap with the fish and the two nets attached to it were lifted onto the canoe with the nets. The door in the back wall of the trap was opened and the catch emptied into the bottom of the canoe. The beaters with their poles and paddles scrambled on board the large canoe, and we paddled off for the next location, off the neighboring island of Matiro.

The next setting faced the dry passage between Matiro and the small islet of Pungapunga. One arm of the race reached a sand bank jutting out from Matiro, and the gap between the end of the other arm and Pungapunga was quickly closed by the beaters as the large canoe paddled in to a strategic position. The beating over, the nets and traps were swiftly demobilized as before, and we went on to the next position between Ramotu and Matuketuke.

There was no hurry but we moved from island to island quickly in the southward direction toward Motukerekere, the last islet in the chain on the eastern side of the lagoon. The trap was practically always set parallel with the shore facing south and the short arm of the race connecting with some sand bank or rocky projection from the shore. The large canoe always swept round to the open part of the race and the beaters swiftly closed in the space between the outer arm and the shore. The trap was being set for the sixth time off Tangawaka islet when a 10-man canoe from Werua arrived to reinforce the beaters. At each new setting, the arc made by the reinforced beaters was lengthened. The noise and the splashing increased as the beaters

seemed to vie with each other, and some added shouts of "Hei, hei." At the ninth setting, off the large island of Hare, we had a brief rest while some of the young men climbed coconut trees and brought us green nuts to quench our thirst.

The setting of the trap continued opposite each island and usually near the passage between neighboring islands, all of which were now cut off from communication with the sea, owing to the state of the tide. The eighteenth and last setting took place at the last island, Motukerekere.

All who took part in the operations came ashore, and the fish were thrown ashore on the coral gravel beach. The native names of the most common were *kara*, *wete*, *hukumanu*, and *hiroa*. The young men who had left at the preceding island now joined us with green coconut leaves which were swiftly plaited into baskets of the *poroporo hari kau* type. There were 28 participants in the drive, including the 10 men from Werua; and King David, who had presided over the trap throughout, supervised the distribution of the fish in 28 heaps, or shares (*tuhanga*). When the names of the recipients of the shares were called, the fish quickly disappeared into coconut-leaf baskets and thence into the canoes. We paddled back to Touhou with a goodly haul of fish and a better understanding of why the nets were short and without sinkers.

It is apparent from the preceding description that the trap was moved quickly from place to place to get as many settings as possible during low tide. It is also obvious that two long nets would have delayed operations, for folding and placing on the canoe would have taken some time after each setting. The short lengths were more quickly and more easily handled. Also, the weight of the nets would have been materially increased if they had been provided with permanent sinkers, for which there was no need, as the floor of the lagoon was covered with pieces of coral of suitable size for sinkers.

WAITING METHOD

A second fishing expedition was planned by King David with the same coir nets and trap, but on this occasion the procedure was different. David and his assistants left during the night for Pumatahati, which was next to the farthest islet of Motukerekere. He said that they would make the preliminary arrangement and we could follow in the morning. We left at about 5 a. m. after a cup of coffee and something out of a can. Hetata was skipper of our canoe and, as there was no wind, we paddled all the way.

On arrival at Pumatahati, we found the trap and the nets already in position. The trap was set near a projecting gravel bank, and the short arm (fig. 139, 1) of the nets reached to within a few feet of the bank. The gap, which was shallow, was blocked by a few dry coconut leaves, and an old man named Rimari lay stretched out beside them to add his bulk to the obstacle.

The outer wing (fig. 139, 2) stretched out parallel with the bank and beyond the projecting point. One man presided over the trap to see that the two wings were properly adjusted and did not block the entrance to the trap. David and some others were strung along the outer wing seeing that the net joins were closed and the stones properly placed on the bottom overlap. An old man at the end of the outer wing acted as a sentry and announced the approach of any fish. The fish were expected to come from the direction of Motukerekere, skirt the curve formed by the rocky interval between the two islands, and pass around the gravel promontory into the waiting arms of the nets. The lookout suddenly shouted that a shoal was approaching and, as it passed his station, dashed in behind it beating the water with a canoe pole. The others along the outer wing joined in the yelling and shouting as the shoal passed them, and they stepped into the race to prevent the fish from turning back. The man at the trap held the nets back to keep the entrance to the trap clear. The fish having entered and the immediate excitement having subsided, we waited for the next shoal. It soon appeared and more shouting and excitement accompanied its entrance into the trap.

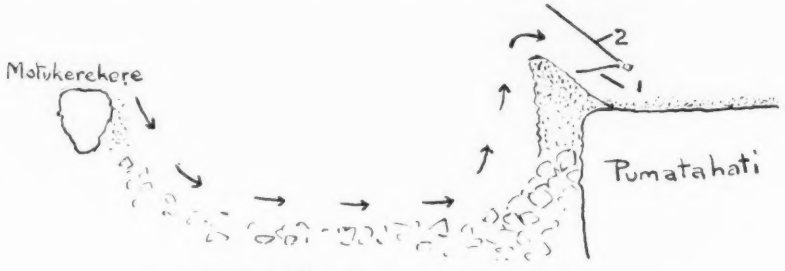

FIGURE 139.—Set trap at Pumatahati.

One of the canoes was brought up near the trap, which was detached from the two end nets. Two men lifted the trap onto the canoe, the door (*tai*) was opened, and the fish were poured into the hold. The trap was then set up as before. A small canoe with a single occupant acted as an outer scout to ascertain the presence of fish. Fish kept arriving in straggly formations, and the canoe hold began to fill.

The experts, however, were not satisfied with the small size of the shoals, so it was finally decided that the trap had been placed too far back from the gravel point, thus turning some shoals off beyond the end of the outer wing. The trap was accordingly moved forward so that the inner wing of the nets rested against the gravel point and the outer wing stretched farther forward to intercept the fish before they turned off. It was rather late, however, so all hands joined in a last drive by beating up the bay toward the point. Excitement mounted as a large shoal was driven forward into the race, and there

was one final wild dash down the race toward the trap. The experts were now satisfied that enough fish had been caught for all and operations ended. The nets were detached and it took three men to lift the trap with its contents onto the canoe.

The fish were thrown ashore from the canoe onto the clean gravel beach, just over 500 of them, mostly of the kind called *kara* in the younger stage and *vete* in the more mature and larger stage. The same fish in the Cook Islands has the name of *vete* which is a dialectical form of *vete*. Because of a thin fleshy outgrowth, or beard, which hangs from the lower lip they are popularly called goat fish in English.

Since 12 men were engaged in the operations, the heap of fish was divided into 12 shares. One man counted the fish out in tens and another laid them on each of the 12 heaps in turn. As the pile diminished, the distribution was made in fives. Each individual thus received a handsome return for the day's sport.

It will be noted that the trap remained stationary and waited (*kana*) for the fish to enter the race. They were certainly driven into the trap after they entered the race, but the method differs from the fish drive, or *hakapakipaki*, method. It is distinguished by the term *kana* which means to wait, hence the term waiting method is a literal translation of the native term *kana*. In the grand finale, however, the method changed from *kana* to *hakapakipaki*, as the bay was beaten to drive fish into the race.

ANGLING

Introduction

Fishing with hook and line is done within the lagoon for smaller fish, such as the *marau pungu*, and beyond the outer reef for larger fish, such as tuna (*takua*). The first inhabitants of Kapingamarangi seen by us were deep sea fishermen in their canoes off the main entrance to the lagoon. The general term for deep sea fishing is *hangota*, a dialectical form of the Samoan *fagota*, but in current speech *angori* is more commonly used. Fishing with a line in the lagoon is termed *hetau*, but with a rod it is *hihi*, a reduplication of the Maori word *hi* which applies to all line fishing. The rod is also used in trolling for bonito in the open sea. Introductory to line fishing outside the reef are the various methods of obtaining bait and the preservation of live bait. For deep sea fishing, the men usually paddle or sail in the evening to Motukerekere and sleep there so as to get an early start through the nearby main channel in the morning. Quite a good house was built on Motukerekere for the use of fishermen.

Fishing Lines

The long lines used for offshore fishing are termed *uka;* but the short, thinner lines used with rods are called *oho,* which is a dialectical form of the general Polynesian name (*aho*) for all lines.

In olden times the lines were made of *roahi,* a term which includes the bast material of the breadfruit, hau, and *warenga.* They were usually two-ply (*uka taka tuarua*), but sometimes three-ply (*uka taka tuatoru*). A three-ply line of breadfruit bast examined was 3 mm. thick and had 12 twists to the inch. Today, the old lines have been superseded by commercial lines both for lagoon and offshore fishing.

Three-ply coir cord (*hari*) was also used in fishing for shark and tuna. It was sometimes joined onto a bast line for the last two fathoms, the reason given being that the bast line did not slip (*marari*) in the fingers when hauling heavy fish into the canoe. The bast part (*roahi*) of the line was referred to as *ti pita me,* the coir part (*hari*) as the *wanuwanu.*

Hooks

Fishhooks retain the general Polynesian name of *matau* pronounced, however with a long initial *a.* Trade hooks have completely displaced those of native manufacture but, though they are no longer made, the people remember them and know how the snoods were attached.

The hooks were made in various sizes, the smaller ones for lagoon fishing and the larger ones for deep sea fishing. The small hooks were made of mature coconut shell (*ipu*), turtle shell (*una ke*), pearl oyster shell (*pa*), and a black shell named *woro* which was obtained in the deep water of the main passage through the reef. This black shell is evidently what Eilers (2, p. 80) termed black snail (*Area cula*) giving the native name as *ti wor.* Large hooks were made of wood for sharks and other deep sea fish.

A small hook of coconut shell was made for the Museum (C.10169) by Johannes, who evidently followed the old technique. The shell was cut to a square or rectangular shape, three corners trimmed off, and the middle part drilled out with the native pump drill. It was then shaped by filing with a piece of branching coral (*kanu*) which formed an excellent rasp. Another form of coral, named *kahika,* was used for smoothing down the inner and outer edges of the shank, bend, and point limb of the hook. A species of bivalve with a rough outer surface like sandpaper was also used. It belonged to the *pipi* group and received the specific name of *pipi ta matau.*

The small hooks were shaped in somewhat circular form but with a rather straight shank limb and no barb. The snood was made of two-ply twisted breadfruit bast or finely twisted two-ply coir fiber and was 1 to 2 feet long.

The snood of the Museum hook is fine two-ply coir cord and is lashed to the shank limb with a fine two-ply cord of breadfruit bast. The binding cord is seized in close transverse turns with a half-hitch here and there (fig. 140, *a*). One of the hooks figured by Eilers (fig. 140, *b*) had a similar seized lashing for the snood. This form of lashing will be described in detail with the larger wooden hooks. It is sufficient to say here that a long strand of breadfruit bast or coir fiber was tied by its middle to the shank limb with a clove hitch and further secured by seizing with the binding thread. The two strands were then rolled on the thigh into a two-ply cord to which fresh strands were added until the snood cord reached a length of 1 to 2 feet.

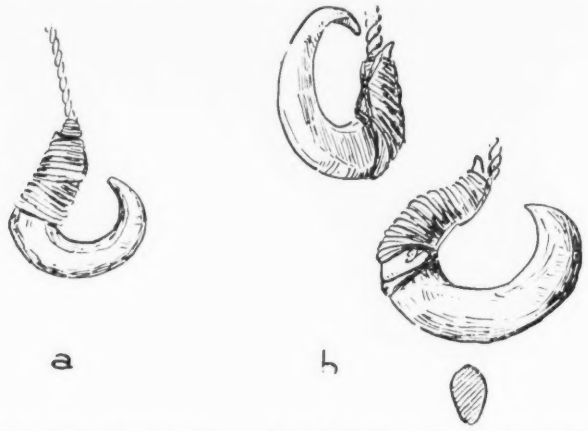

FIGURE 140.—Small hooks: *a*, in Bishop Museum; *b*, after Eilers.

The larger shell hooks were made in circular form, but some were shaped with the outer side of the shank limb fairly straight and forming a rounded angle with the lower edge of the bend. None of these hooks were obtainable, but some of them were figured by Eilers (*2*, pp. 75, 76) and are reproduced in figure 141, *a-d*. They have a shank knob on the inner side and the upper end of the shank limb is notched for a peculiar form of snood lashing. A broken hook (fig. 141, *c*) has a distinct angle at the outer junction of the shank limb with the bend. The points of two of the hooks (fig. 141, *b*, *d*) have a slightly downward projection which has the appearance of a very small barb.

On seeing Eilers' illustrations, an old man named Tukohi announced that he knew how to make the lashing. The length of the hooks was given by Eilers as 1.5 to 2 inches. As none of the original hooks were procurable, Alfred Patterson made one of breadfruit wood by copying one of Eilers' illustrations and Tukohi demonstrated the method of lashing the snood upon the wooden example. He proceeded to make a three-ply cord from strips of hau bast to form the snood. The cord was made by the *taka* process of rolling

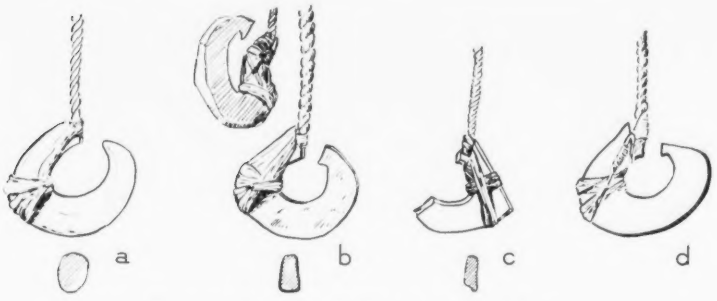

FIGURE 141.—*a-d*, shell hooks, after Eilers.

the plies on the bare right thigh, and Tukohi rolled the three plies just as readily as two plies. He gradually thickened the cord from 3 to 4 mm. by adding thicker strands of bast as he progressed to the length of two feet. Here he stopped leaving three long untwisted plies with which to form the lashing. He divided the three plies into four equal strands and then fitted the end of the twisted cord into the notch on the upper end of the shank limb with two untwisted strands on each side of the shank limb. He passed downward the inner strand on each side and drew them taut on the under side of the bend. After some manipulation to get the snood cord fitting properly in the shank notch, he loosed the strands from below the bend, crossed them over the inner side of the shank limb, and then passed them again under the bend of the hook. The subsequent procedure is shown in figure 142, *a-f*, and described below.

a shows the snood placed in the notch on the upper end of the shank limb with two strands (1, 2) from the cord on the near side and two (1′, 2′) on the far side, the inner one (1) being directed downward and the outer one (2) drawn back out of the way. The inner strands (*b*, 1) after being pulled taut are crossed over the inner side of the shank limb and brought down to the bend, crossed under the bend and brought upward to the side of the snood. The outer strands (*c*, 2) are crossed obliquely over the inner side of the shank and then make horizontal turns around the middle of the shank limb to bind down the vertical turns of the inner strands (1). The inner strands which have become vertical strands (*d*, 1) are passed around the snood in the notch and then descend to make additional vertical turns around the lower edge of the bend.

In *e*, more horizontal turns are made with the other strands (2) and crossed turns and vertical turns by the vertical strands (1). Having made as many vertical and horizontal turns as the craftsman thinks fit (*f*), he proceeds to finish off the lashing by seizing the last vertical turns on each side with the horizontal strand on that side. The ends of the vertical strands are fixed in the seizing turns which proceed upward from the horizontal band of lashing. The seizing turns are in half-hitches which fix the ends of the transverse strands at the upper end of the seizing.

At the stage *e* in figure 142, the craftsman pleases himself as to the number of vertical and transverse turns he makes. In the more rounded hooks (fig. 141, *a*, *b*, *d*) the vertical and the transverse turns come close together, but

in the broken hook (fig. 141, *c*) with a distinct outer angle between shank and bend, the two sets of lashing turns are well-separated, like those made by Tukohi. Of the four lashings in figure 141, only one (*d*) has the upper part of the vertical turns seized.

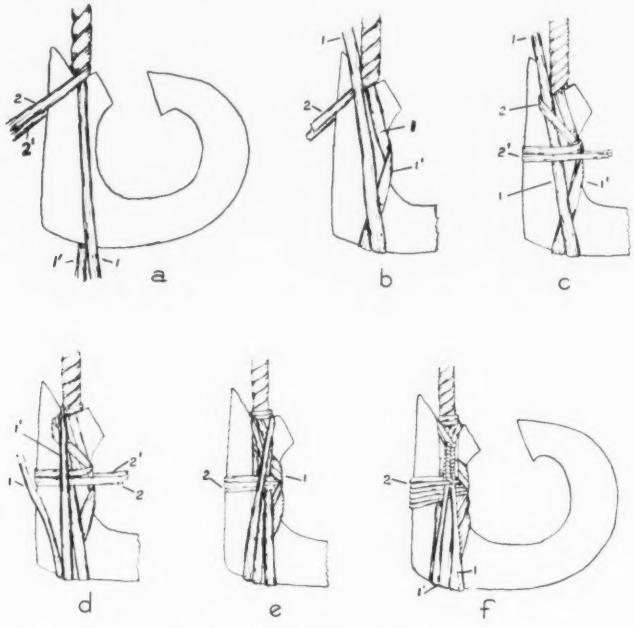

FIGURE 142.—*a-f*, snood lashing.

WOODEN HOOKS

Larger hooks for deep sea fishing were made of wood. Though mainly associated with catching sharks (*mango*), hence termed *matau mango*, they were also used for catching other deep sea fish. They were made of a bent branch or a bent root of *pua* which furnished the shank limb and the bend of the hook. The point limb and the point were supplied by another curved piece of wood which was joined to the main piece with a long slant join lashed together with close transverse turns of a fine coir cord. The commencement end of the lashing cord was bent upward and fixed by the transverse turns which covered it. The finishing end was pushed back under the last two or three turns of the lashing, the looped turns being loose to admit the cord and then tightened in turn, the slack pulled out, and the surplus cord cut off.

A wooden hook figured by Eilers (2) has the main piece of wood curving outward from the bend to form most of the point limb (fig. 143). The com-

posite point has the same tendency to a barb that was present in some of the shell hooks. The snood lashing to the shank is seized, as for the small shell hooks; and the second cord ends in the eye, in which the end of the cord, after forming a loop, is seized to the standing part.

A number of wooden hooks were made for us from naturally curved *pua* wood, and the points and snood were lashed with the old technique by a master craftsman named Huoti.

FIGURE 143.—Wooden hook, after Eilers.

The selected wood of the right thickness forms the shank limb, the bend, and the point limb. The point is attached to the point limb by cutting a long slant on each and lashing them together with close transverse turns of a two-ply coir cord, the commencement end being turned upward and fixed by the succeeding transverse turns. The finishing end at the upper end of the lashing is passed back under the last two transverse turns, which are made loosely and then drawn taut. The slack is pulled through and the end cut off.

The upper ends of the shank limbs have no knobs but are cut with fine notches on each side to prevent the snood lashing from slipping off. The snood (*taka*) of one hook is formed of long strips of hau which are knotted to the shank limb and then further fixed by a binding coir cord which forms seizing turns. Two varieties of seizing are used, and the one used with the hau bast snood is described as follows and shown in figure 144, *a-d*.

In *a*, the middle part of a length of hau bast is formed into a clove hitch, which is slipped down over the shank limb to the lowest side notches, and drawn taut (1). A second strip (2) is likewise fastened around the notch above; a third strip (3), below the first strip. The six strands so formed are drawn upward along the inner side of the shank limb. A binding cord (see 4) with a stopper knot is tied to the shank limb with an overhand knot below the clove hitches and commenced with an underhand half-hitch to cover the attachments of the hau strands with serving turns. In *c*, the hau strands are firmly bound to the shank limb by close seizing in underhand half-hitches. And in *d*, the hau strands, divided into two equal plies (*kauanga*), are twisted into a two-ply cord (5). The end of the binding cord is carried around the snood cord in a double overhand knot and cut off.

The snood cord is continued with the addition of fresh strands until it reaches the required length of 2 to 3 feet. If the binding is left uncut, additional half-hitches are continued around the snood.

The other variations occur in the snoods of shark hooks in which the snood plies consist of two-ply coir cord and the binding cord uses crossing knots (fig. 83, *c*) instead of half-hitches. The technique is shown and described as follows in figure 144, *e-h*.

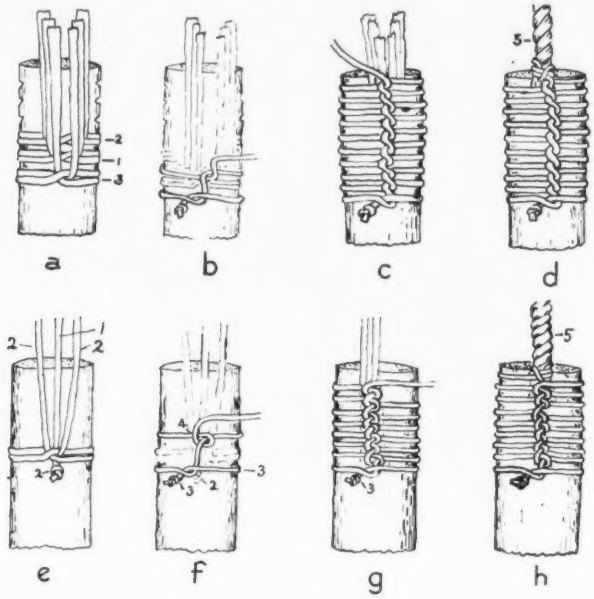

FIGURE 144.—Snood lashings: *a-d*, with hau bast; *e-h*, with coir cord.

The odd cord (*e*, 1) with a stopper knot is laid against the inner side of the shank limb. A longer cord (2) is formed into a clove hitch in its middle, slipped down over the shank limb and drawn taut above the stopper knot of the first cord to fix it. In *f*, the binding cord (3) is fastened to the shank limb with an overhand knot at the lower edge of the three cords, and seizing turns are made over the three cords. In making the hitches, the cord passes to the right around the shank and, entering on the left, passes over the loops, turns to the left under it and then over itself to form a crossing knot (4). When the seizing turns reach the end of the shank limb (*g*), the three snood cords are twisted into a three-ply fine rope (*h*), and the binding cord makes a few close turns around the rope snood (5) or may be continued along it in a series of spaced half-hitches.

Of two shark hooks in Bishop Museum (C.9992 and C.9991), one (fig. 145, *a*) has a wide bend which gives it a circular appearance. The point is attached to the shank limb with the usual close transverse turns, and it ends in the peculiar short under projection resembling a primitive barb. The binding of the snood follows the half-hitch method (fig. 144, *a-d*). The length of the

hook is 7 inches, the width 5 inches. The second hook (fig. 145, *b*) is larger and its point has a well-developed barb with a marked concave curve on its inner side. This form of barb appears to have been copied from trade hooks rather than being a natural evolution from the primitive barb illustrated in figures 141, *b*, *d* and 143. The binding of the snood to the shank follows the crossing knot technique (fig. 144, *c-h*), and the binding cord is continued in close turns around the snood. The snood ends in a loop, which is spliced, which also appears to be modern by comparison with the seized end in the older hook figured by Eilers (fig. 143). The snood loop is for the purpose of easy attachment to the line, the end of the line being tied to it with a knot resembling the netting knot. This larger hook is 10.75 inches long and 5.75 inches wide.

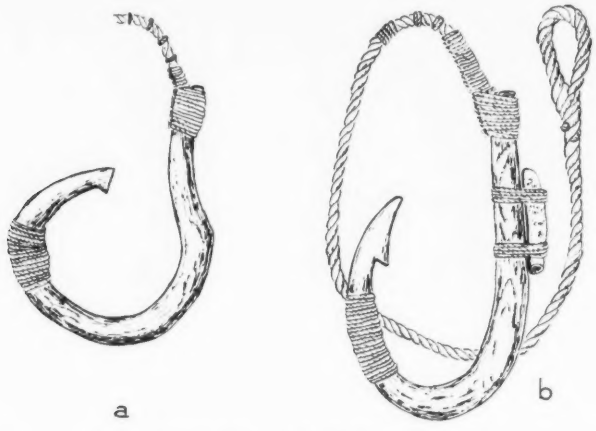

FIGURE 145.—*a*, *b*, shark hooks.

The sinker in shark hooks is an elongated piece of coral which is tied to the outer side of the shank limb with an upper and lower set of close transverse turns with a two-ply coir cord. In the Museum hook (fig. 145, *b*) the sinker appears too light, but it serves to illustrate the method. Eilers (*2*, p. 76) states that the sinkers used with the large shark hooks were correspondingly large.

BONITO HOOK

Bonito fishing by trolling with a lure appears to be on the wane in Kapingamarangi. The lure or bonito hook (*pa*) was a composite hook with a pearl-shell shank (*ti waka pa*) and a turtle-shell point (*kawiti*). These are now rare, for I saw only one on the atoll. Another one, collected there by Robert O. Smith, was given to the Museum. These two hooks differ materially from the specimen figured by Eilers (*2*, p. 75) and reproduced in figure 146, *a*.

The shank of the Eilers hook was evidently formed from the hinge part of the shell which has affinity with the Marshall Islands technique. Eilers describes it as having ends like a fishtail in two tips, the side planes meeting to form an edge and continuing as a kind of rail to support the base of the point, and the point having a distinct barb.

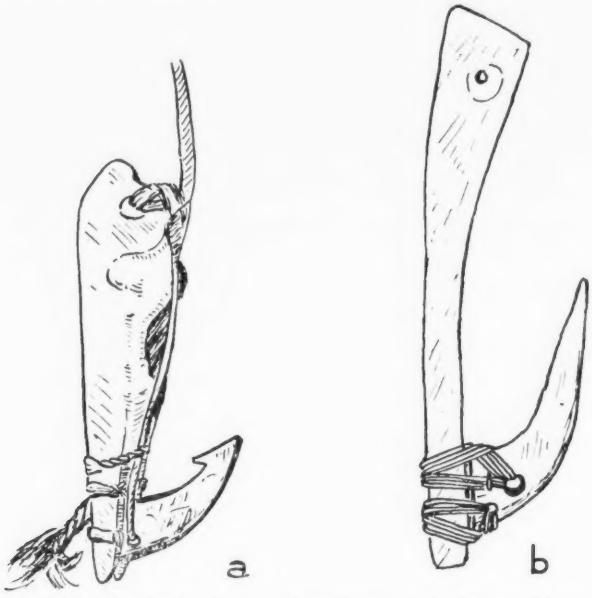

FIGURE 146.—Bonito hooks: *a*, after Eilers; *b*, in Bishop Museum.

The hook seen by me on Kapingamarangi, owned by Alfred Patterson, closely resembled the Museum hook shown in figure 146, *b*. The length of the shank was 70 mm., the thickness of the head 8 mm., and the distal part of the shank 6 mm. The head of the shank was peculiar in not ending in a point, but the planes of the side surfaces came together to form an edge. The point piece of turtle shell had two holes bored through the base, which was an even expansion without any proximal or distal prolongation. The two holes were not on the same level, the near hole being higher and much larger than the other. The lashings of breadfruit bast passed through the two holes and around the shank. In the lashings of the large hole, some turns passed down vertically and others were crossed in front of the point base. The point had no barb. The hackle was a piece of cloth included under the two lashings of the point base, but formerly it was made of fibers of breadfruit bast. No specific name for the hackle was remembered; it was simply referred to as *kiri kuru* (breadfruit bast). The snood was looped through the large hole in the point base and was also lashed to the head by a fine cord which passed

through the transverse hole in the head and around the snood. The snood received the name of *oho*, the same name as the line.

The bonito hook in Bishop Museum (C.10170) is a little larger than Patterson's hook, but it resembles it closely. The shank is 82 mm. long, the head 12 mm. wide and 11 mm. high. The head has a similar proximal edge instead of a point. The shank narrows toward the distal end, which is 6 mm. wide and 4 mm. thick. The point piece is made of turtle shell 3 mm. thick. It is 39 mm. long over all, and the base is 13 mm. wide. A hole is bored through the base toward the far end. A second, larger hole is pierced at a higher level so that it is actually on the ascending part of the point piece. The point has no barb (fig. 146, *b*).

The lashing of the point piece to the shank is peculiar because, instead of one set of through and through turns as in Polynesian hooks, the lashing turns of each hole are in two sets, one vertical and the other crossed on the outer ends of the point base, as described below and shown in figure 147.

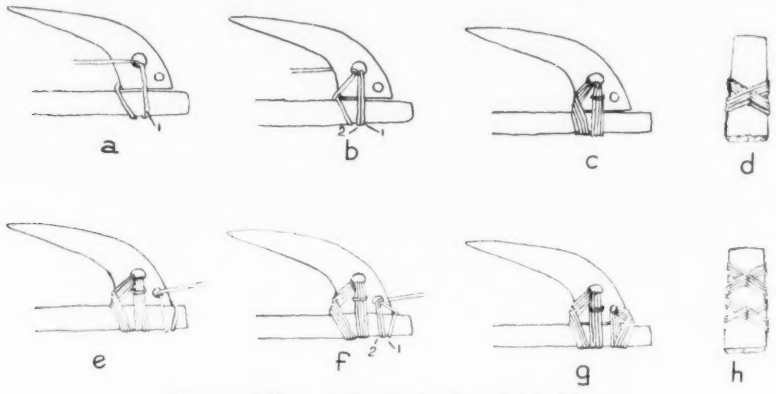

FIGURE 147.—*a-h*, bonito hook, point lashing.

The binding thread (*a*, 1) has its end bent under the shank to be fixed by subsequent crossings. The thread ascends upward to the large hole, passes through it, descends obliquely on the far side to the left angle of the point base and the shank, crosses obliquely downward on the near side of the shank, crosses on the under side of the shank, ascends vertically to the large hole on the far side, and passes through the hole to the near side. In *b*, from the position *a*, the thread passes obliquely down from the hole on the near side to the left angle, descends obliquely across the shank on the far side, crosses on the under side to appear on the near side of the shank, ascends vertically (*2*) on the near side to the hole on the left of the first vertical turn (1) and passes through the hole to the far side.

In *c*, the sequence of turns in *a* and *b* are followed until four complete turns have been made in each set. The last vertical turn on the near side is passed around the vertical set of four turns in an overhand knot, passes through the hole and makes a similar overhand knot around the four vertical turns on the far side. The thread is cut and the lashing of the upper large hole is completed. The back of the shank shows the crossing of the two sets of four turns from each side (*d*).

In *e*, a second thread also has its end bent under the shank and is brought up vertically on the near side, passes through the small hole, descends on the far side to the back angle between point base and shank, crosses the shank obliquely to the left on the near side, crosses under the shank to ascend vertically on the far side to the hole and passes through it to the near side. In *f*, the thread descends obliquely on the near side to the back angle, crosses the shank obliquely to the left on the far side, crosses under the shank and ascends on the near side (*2*) to the hole through which it passes to the far side. As shown in *g*, the sequence of turns resembles that of the large hole and the turns are continued for four turns in each set; and the thread makes an overhand knot around the vertical turns on the far side to fix the lashing. The back of the shank shows the crossings of the lashing turns of the two holes (*h*).

The Museum hook has no snood, but Alfred Patterson's hook is complete with snood, line, and rod. The snood is passed through the large hole in the point base and doubled back toward the head of the shank, where the snood is lashed to the head by a fine cord passing through the head hole and over the snood in a number of turns. The line to which the snood is attached is 9 feet 5.5 inches long and the bamboo rod 10 feet 3 inches long. Besides an ornamental sennit lashing at the base of the rod, there is a small loop in which the hook point is caught when not in use.

It is evident that the Museum hook and Alfred's hook belong to Kapingamarangi and hence establish this particular type. It has more affinity with the Polynesian bonito hooks than the type figured by Eilers. As some communication took place in the past between the Marshall Islands and Kapingamarangi, there is a strong possibility that Eilers' hook was based on the Marshall Islands technique.

Hook Holder

The hook holder (*rakau matau*) was described by Eilers (*2*, p. 74) as a pinning board for small hooks. A specimen (fig. 149) was made for Bishop Museum with the old-time technique. This specimen (C.9998) is formed of a piece of wood 17.5 inches long, 0.8 inch wide, and 0.6 inch thick in the middle. The ends slope gradually to a narrower width and are notched to provide for the initial and final turns of the cords which make loops for holding the hooks. A long two-ply cord is doubled in the middle to form a loop 5 inches long, and the loop is fixed by tying the doubled cord in an overhand knot. The doubled cord then makes an overhand knot around the notch at one end of the stick. The two cords now act as individual cords. With the stick held horizontally with the loop to the left, the cords are referred to as the upper cord and the lower cord. The formation of the loops for the hooks is described below and shown in figure 148, *a-c*.

At the second notch, 0.3 inch from the first, the upper cord (*a*, 1) passes upward at a right angle, descends vertically on the back, turns upward from the lower border to the front, and passes under its standing part to form a half-hitch. The lower cord (*b*, *2*) makes a turn downward on the right of the first cord (1), ascends on the back,

turns down on the front from the upper border to pass under the free end of the upper cord, and passes under its standing part to form a half-hitch. In *c*, the two cords pass on to the next notch. The upper cord (1) repeats the movement in *a* and the lower cord (2) repeats the movement in *b*.

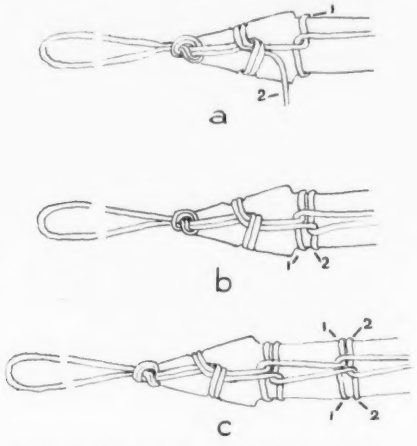

FIGURE 148.—*a-c*, hook holder technique.

The above technique is continued for the length of the stick, thus providing 21 horizontal loops for the insertion of hooks. The passing of the half-hitches under the standing parts of their respective cords raises the horizontal course of the cords above the surface of the stick and thus makes it easier to pass the points of the hooks under the horizontal loops.

After completing the hook loops, the two cords are tied with overhand knots to the last notch on the right end of the stick. They are then twisted together into a thick two-ply cord for 30 inches and knotted at the end (fig. 149).

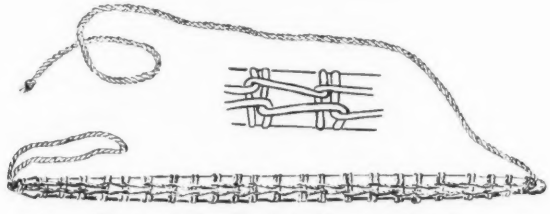

FIGURE 149.—Hook holder completed.

Formerly, the hook holder not only stored hooks at home, but it was carried along in the canoe when the owner went fishing. He selected the hooks he expected to need and placed them in the holder. Before he started fishing, he spread out his hook holder by placing the loop of one end over a false boom that was near him. He then stretched the cord at the other end

and tied it to another false boom or some other convenient part. Thus, when a fisherman broke a hook or wished to change one, he reached over and selected the appropriate hook.

Rods

Short fishing rods are used in the lagoon with a short line, particularly in fishing for *marau*. The term for rod fishing in the lagoon with a baited line is *hihi* and, according to informants, the same term is applied to the rod. Evidently any piece of wood serves. Rod fishing is also conducted at the edge of the outer reef. The hooks were formerly the smaller ones made of coconut and marine shell, but now trade hooks are used.

The rod used with the bonito hook was more important. The only old one seen was that owned by Patterson. It was a bamboo rod, 10 feet 3 inches long and is said to have drifted to the atoll. The butt end of the rod was ornamented with a lashing pattern with three-ply coir braid in a close pattern of lozenges of the same technique as the pattern used in Mangaia (Hiroa, 6, p. 47). Bands of triple overhand knots were spaced along the rod to prevent it from splitting. The line attached to the rod was 9 feet 5.5 inches long and was termed *oho*. The bonito hook attached to the end of the line was hooked into a loop made with cord at the lower end of the ornamental lashing.

The bonito rod was named *matira* and the spaced bands were termed *tiatia*. Alfred Patterson used the phrase, "Ti matira ku tiatia" (The rod has been banded). Bamboo is also termed *matira* and is used as laths for the inner layer of fish traps. However, as bamboo is not a native plant and was obtained by drift or, more recently, by importation, it may be assumed that *matira* was the original name for fishing rod and that when the drift or imported bamboo was found to form excellent fishing rods, the name of *matira* was applied to it also. The name of *matira* for fishing rods must be old, as it occurs in New Zealand, and in Samoa as *matila*. The use of a three-ply coir braid or sennit in the ornamental lashing is interesting, as it is the only instance in which we saw sennit used. According to Patterson, it was used on the rod by an old man many years back, but Patterson himself did not know the technique of the lashing pattern. It is possible that three-ply coir braid was used more extensively in the past, giving way to left-hand cord which is more quickly made.

Sinkers

Sinkers take different forms in three methods of fishing: line sinkers within the lagoon, shark hook sinkers, and temporary sinkers in deep-sea fishing. The sinkers used with line fishing within the lagoon are termed *hetau*, a term also applied to the form of fishing. They are made of coral and are

grooved for the cord attached to them. A short length of coir cord is attached to the sinker by its middle so as to leave two free ends, one for attachment to the line and the other to the snood of the fishhook. Thus, in tying the cord, the left end is left long and the cord is held against the groove with the left thumb. Two loose turns are made around the groove, and the cord passed back over the loops and through them from the near side. Each loop is drawn taut and the slack pulled out with the result that the cord is firmly bound to the groove of the sinker with a double overhand knot (fig. 150, *a*). For actual fishing, one end of the cord is tied to the end of the fishing line with the equivalent of a weaver's knot (fig. 150, *b*). The other end is tied to the snood of the fishhook with a slip reef knot which facilitates the removal of the snood if the hook breaks (fig. 150, *c*). The sinker cord is of coir or hau bast. Breadfruit bast is not used as it gets too soft in the water and might become entangled with the hook.

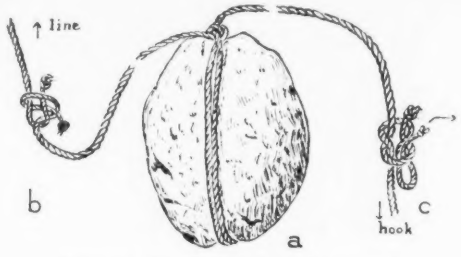

FIGURE 150.—*a-c*, sinker with cord.

Shark hook sinkers are thick pieces of branched coral, one piece being laid against the outer side of the shank limb and bound to it by two lashings of close transverse turns near each end. The sinkers are not very heavy, but are sufficient to sink the wooden hook below the surface of the water to the upper depths frequented by sharks. These sinkers usually remain permanently attached to the hooks.

Temporary sinkers used in deep sea fishing for tuna and other fish consist of large pieces of coral picked up from the lagoon bottom and heavy enough to carry the lines to the bottom in deep water. A number are placed aboard the fishing canoe, for one is used and discarded at the bottom of the sea every time the baited line is dropped over the side. The method of combining the baited hook, ground bait, and temporary sinker, shown in figure 151, *a-f*, is described as follows:

> The baited hook and pieces of ground bait are placed on a piece of breadfruit leaf (*a*). A rectangular sinker (*b*, 1), side view, is placed on the breadfruit leaf (2) which overlaps the side of the sinker. The line (3) from the baited hook emerges from between the leaf and the sinker. The line (*c*, 4) makes a turn around the sinker and the leaf at each end so as to secure the leaf to the under surface of the sinker.

On the upper surface of the sinker (*d*), the line (5), after making a couple of extra turns around the middle, is passed over the left thumb, which is placed on the sinker, and withdrawn to form a loop (6). In the next turn (*e*, 7) of the line, a slip loop (8) is drawn through the thumb loop. The preceding turn (*f*, 5) of the line is drawn taut to eliminate the thumb loop and draw the turn taut over the slip loop (8). The slack is drawn taut by pulling on the slip loop, and the slip loop reduced to convenient size by pulling gently on the line (7).

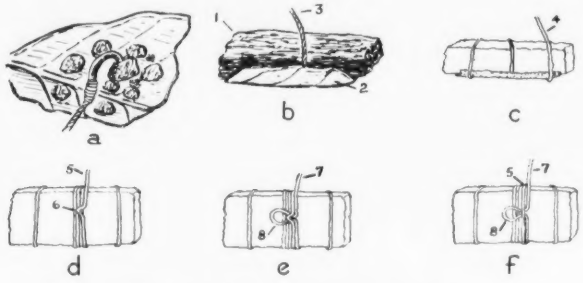

FIGURE 151.—*a-f*, sinker with ground bait wrapping.

The sinker and leaf wrapper are dropped overboard and the heavy sinker carries the line to the bottom. The fisherman jerks (*ruru*) his line and the slip noose pulls out freeing the sinker (*ka mahete ti hatu*) and the leaf to expose the ground bait and the baited hook. Thus, the heavy sinker performs its function of carrying the baited hook to the depth frequented by large fish and is automatically discarded to save the fisherman the extra exertion of hauling it to the surface.

BAIT

Bait retains the widely spread Polynesian name of *mounu*. There are four main sources of supply. Hermit crabs (*unga*) are procurable in quantity along the beaches of all the islands. If quantity is required, they are collected in the closed coconut-leaf basket termed *poroporo unga*. The shells are cracked and the fleshy part within the shell house is used as bait for lagoon fishing with the fine line with a sinker, or with the rod. The fish caught are principally *marau pungu*, which are used largely for bait in deep sea fishing. When caught by line or rod, they are kept alive in water in the bottom of the canoe. On shore, the live fish are transferred to the live-bait receptacle termed *u hakatari marau pungu* and kept alive in the lagoon until needed. *Kupe* and other fish are also caught and kept in live bait containers.

The *tauwene* are small fish that move in small shoals and are caught in the *tae tauwene* net. Fishermen usually use the net in the shallows in the lagoon on their way along the outer islands to the main channel by which they go out to sea.

Flying fish (*tawe*), which are excellent bait for tuna and other deep sea fish, are caught the night before outside the reef with torch and flying fish net, as already described.

In preparing bait, the flesh is cut off in a large slice from each side of the backbone and cut into smaller slices as required. With modern metal hooks, the bait is not tied on. Formerly, the bait was slit, applied to both sides of the point limb below the point, and tied onto shark hooks. The point of the hook was exposed above the bait, but that did not seem to matter.

Ground bait (*hakaruru*), or chum, is always used in deep sea fishing. Hence, in addition to a supply of stones for sinkers, the fisherman also takes a number of breadfruit leaves. After he baits his hook, he prepares a quantity of ground bait by biting the head of a flying fish into three or four pieces and part of the body of the fish. These he spits out onto a piece of breadfruit leaf held in the left hand. He places the baited hook onto the chewed ground bait and folds the leaf around them in a neat package. This is then lashed to the sinker with some turns of the line and a slipknot, described in the section on sinkers. When the slipknot is freed, the ground bait spills out (*ka maringi ti hakaruru*).

Lagoon Fishing

Line fishing (*hetau*) within the lagoon is conducted with fine lines, small hooks, and hermit-crab bait. The coral sinker is attached to the end of the line by one end of the sinker cord, and the baited hook is tied to the other end of the sinker cord. When the sinker touches bottom, the line is drawn up for the length of line between sinker and hook so that the hook lies on the bottom. Now and again, the line is slackened quickly so that the sinker bumps against the coral bottom with a thud, the sound of which is said to attract fish. The fish most commonly caught is the *marau pungu*, which is kept as live bait. However, a list was obtained of no less than 24 kinds of fish caught in the lagoon with a small hook and with hermit-crab bait.

Rod fishing (*hihi*) for the same kinds of fish is conducted both in the lagoon and on the sea edge of the reef.

Bonito Fishing

Rod fishing for bonito (*atu*) is carried out at sea with the pearl-shell lure (*pa*) trolled from a rod (*matira*). In Kapingamarangi, the term for rod fishing at sea is *hihi*, the same as for lagoon rod fishing. In Nukuoro, however, trolling with a rod is termed *karere* and the bonito hook is called *pa karere*.

In the Kapingamarangi canoes with a wide space between the gunwales, crossed sticks were lashed across the hull opening opposite to the second

false boom from the stern termed the *kioto heu pa*. It was called the *rongo-rongo* and served the same purpose as the fisherman's stand in the bow. It supported the legs of the fisherman with the rod who faced the stern and cast his hook in the water between the wakes made by the hull and the outrigger float. Like the fisherman's stand, this apparatus has gone out of use with the abandonment of the Kapingamarangi type of canoe.

Deep Sea Fishing

Deep-sea fishing with line and hook is termed *hangota* or, more generally, *angori*. A canoe going out to fish beyond the reef is termed a *waka angori*. On the day of our deep-sea fishing expedition, we set out from Motukerekere in two canoes in the early morning. The lines and a supply of green breadfruit leaves had been brought from Touhou. The canoe in which I rode was manned by two men, and I joined in paddling. Two long fishing lines lay coiled on the outrigger platform, and leaves and flying fish for bait were in the hold. We set out toward the main passage (*ti awa*) by which ships enter the lagoon, with the men using poles in the shallow water. A short distance from the island, both canoes stopped and the men jumped out to collect flat pieces of coral (*hatu*) from the bottom to serve as sinkers. Each man collected his own supply of the right size and weight, many pieces picked up being cast aside as too light. Each man in my canoe collected quite a large pile of stones, which they placed in their respective ends of the canoe. Other canoes were seen along the shallows using the *tac tauwene* net to procure bait, which they had not provided beforehand.

When we left the shallow water, poles were relinquished for paddles. We passed through the passage and kept on for about a mile beyond the reef. Here the men ceased paddling, took up their lines from the outrigger platform, and laid the coil neatly across the gunwales beside them. I concentrated my attention on the man in the stern and sat facing him with notebook in hand. The canoe drifted but little and no anchor was used. In fact, no anchor was carried.

The stern fisherman picked up a flying fish and scaled and gutted it with a knife. The neatly coiled line which lay beside him had one hook attached to the end of the coil which was uppermost. The fisherman cut off a long slice of bait from one side of the fish and, picking up the single hook, impaled the bait, using no bait tie. He then picked up a breadfruit leaf from the hold, and tore off a section with his teeth. Holding the leaf section in his left hand, he placed the baited hook upon it. Then he picked up the flying fish from which he had cut the bait and bit the head into three pieces which he dropped on the hook. He bit off some more pieces from the body and dropped

them on the hook and leaf to provide the ground bait (*hakaruru*). He then picked up a stone from his pile and placed it on the bait. He seized the line where it emerged from the leaf and wound it around the sinker and the leaf below it so that the leaf with its contents was bound to the under side of the stone. When enough turns had been made, he made a thumb loop and formed the slip loop shown in figure 151.

The sinker was thrown out a few feet from the hull on the side opposite the outrigger and the line paid out as the sinker carried the hook and bait to the bottom. The arrival of the sinker at the bottom was tested by lifting the line a little and dropping it. Next, the line was drawn up a little distance so that it would be taut and jerked (*ruru*) upward to release the slipped loop. The release freed the hook and ground bait and also got rid of the sinker, which would have added extra weight in pulling up the line if permanently attached to it.

After the line was held for some time in expectation of a bite, the fisherman decided to bait another line. The fisherman drew the line across the front of his body and hitched a loop of the line under the taut upper edge of his kilt, to free his two hands. I had noticed that the coil of line across the gunwales was as long or longer than the length of line already let out. I imagined that this extra length was for deeper water, farther out, but to my surprise, the fisherman turned the coil over and revealed another hook fastened to this other end of the double line. He quietly repeated his performance of baiting and dropping the hook, being careful to throw the second line out as far from the first as possible to avoid tangling the two lines. His colleague at the other end of the canoe had followed the same procedure. I did not look around, but when I heard the crunching of a fish head I knew that he was preparing his ground bait. In fairness to the fishermen, it must be stated that the fish were fresh, scaled, and gutted and that after the hook had reached bottom, they scooped up sea water in their hands to rinse out their mouths.

My fisherman now determined to haul in his first line to examine the bait. He freed the hitch of the first line to his waist and hitched the second line in its place. He began to haul in the first line, but instead of bringing the coils into the canoe, he dropped them over the side into the sea and even threw some of the coils out wide to prevent tangling in the water. There was more room in the sea than in the narrow canoe. However, when the line was well over halfway up, he began to lay the coils across the gunwales of the canoe. He drew up with the right hand while the left hand grasped the line a little below the right. When the right hand had again grasped the line an arm's length below, the left hand threw the slack forward with a twist so that it made a neat coil across the gunwale which at that part was only seven

inches across. The coil grew and at last the hook came up with the bait intact. After examination, the baited hook was thrown forward on top of the coil. It must be remembered that the slack line in the sea was continuous with the first turn on the under side of the coil. The fisherman, therefore, picked up the coil with the hook and turned it over so that the upper turn would now be continuous with the slack in the sea. He began to haul in the slack and to throw the turns forward on the part of the line already coiled. In this way, there was no break in the continuity of the individual turns in the coil and tangling was avoided.

With all the slack drawn in and the coil completed, the hook was underneath. As the line runs better from the top of the coil, the fisherman turned the coil over as he had done with the line which was still down. He looked at the bait and decided to substitute fresh bait. He went through the same process of attaching the baited hook and ground bait on a leaf to another sinker and threw it out away from the line which was out, then alternated between his two lines. Every time a line was drawn up, even without changing the bait, a fresh piece of leaf, more ground bait, and a new sinker had to be prepared to carry the hook down again. As he looked at his hooks fairly frequently, I began to realize why such a large number of stones had been put on board. Sometimes when a stone was judged to be too light, another stone was added and the two looped together with the bait as one package. Occasionally, the slip noose around the stone would not jerk loose, and once the fisherman had to haul up his line to readjust the slip loop.

While it was intensely interesting to note all the details, I waited anxiously to see what would happen when a fish took the bait. Fish seemed to be scarce, and we shifted position by paddling to various places, sometimes nearer the reef and sometimes farther out. Attempts were made to attract fish to the vicinity by making a commotion in the water, beating the side of the canoe, or splashing the water with the paddle. The paddle blade was held horizontally and at an acute angle with the water, and sharp, quick strokes were made which created sound and motion in the water. This action was termed *tarai,* its continued repetition, *taratarai.* The sound and movement in the water was supposed to convey information to the larger fish that shoals of smaller fish were in the neighborhood, but we received no response.

When hope ran low, we heard a shout from our sister canoe. One of her two fishermen was standing upright and hauling (*huti*) with vertical pulls on his line, which evidently was heavily weighted. When the line was about halfway up, he called to the other fisherman for aid. The other dashed forward, seized the line, and continued the vertical pulls until the head of a large tuna appeared beside the canoe. The fish was held against the side of the canoe until it was killed by blows on the head with a heavy stick (*ko*) carried

for the purpose. The fish was hardly hauled into the canoe when the fisherman I had watched in our own canoe, suddenly sprang to his feet and began hauling up his line with the same upward movements, but at times he could hardly move the line. It was strenuous work and at about halfway, he also began to call for help. The other fisherman quickly came to his aid, seized the line, and continued the upward hauling without a break. The neat coiling of slack was impossible, but I noticed that the relieved fisherman arranged the line in some order as the turns of slack were dropped. Finally, the head of a large tuna broke water. It was also killed before being hauled over the side, for there is not much room for a large fish to thrash about in a canoe.

The hauling in of a large fish like the tuna demands a special grip on the line termed *hakarara*. With an ordinary grip, the line would be likely to slip through the fingers and burn them. I had been told about the special grip on shore, but I now realized how necessary it was with fish of the weight and strength of tuna. The fisherman stands upright and reaches down to get a full arm hold on the line. He grasps it with the palm of the right hand and, as he does so, clamps the line with the thumb against the first phalange of the forefinger. He raises the line to shoulder height, grasps it with the left hand just below the right, and then reaches down with the right hand for a fresh low grip on the line. By such straight upward pulls, the fish is brought to the surface. The clamped grip with the thumb holds firm throughout, and there is no possibility of the line running through the fingers during the struggles of the fish. The fisherman may be on the verge of being pulled overboard but the grip on the line cannot be broken.

We tried again in various places but the excitement of a catch was not repeated. The fishermen said the day was wrong (*huaaitu*) because it was too bright and the fish were not swimming near the bottom. We expressed our satisfaction with the morning's catch, so the lines were coiled and laid on the outrigger platform and we paddled through the reef channel and the four miles back to Touhou. We had had another demonstration of the value of direct observation.

Trolling with a baited hook for tuna was introduced from Nukuoro, where trolling with a line (*uka*) was termed *arohaki*, by Alfred Patterson.

Noosing Shark

The shark noose is, or was, used to catch sharks in much the same way as in Samoa. The noose specimen (C.9999) prepared by King David consists of a three-ply rope (*hari*), 9 feet 8 inches long and 0.6 inch thick (fig. 152). One end is bent in with an overlap to form an eye, and the eye and the overlap are seized in close turns with a two-ply cord. The other end is also formed into an eye, but only the overlap is seized. One end of the cord is passed

through the seized eye to form a noose which is adjusted to the size of the shark attracted. The noose part is termed *here*, the whole article, a *taumoko*. With the stiff *hari* rope, the noose holds its shape. A piece of fish to serve as bait is suspended by a cord from near the eye so that it hangs in about the center of the noose.

FIGURE 152.—Shark noose.

The Samoan shark noose is very similar to that of Kapingamarangi in being formed of three-ply rope of coir fiber, but in Samoa, three-ply braid is used for the plies instead of two-ply cord.

Two fair-sized Tridacna shells (*pahua*) are carried in the canoe as part of the equipment. My informants were very particular as to the way in which the shells must be held. The lower shell, held in the left hand, must have the inner surface facing upward. The inner surface of the upper shell, held in the right hand, must face toward the hinge of the lower shell. With both shells held under water, the right hand grates (*oro*) the edge of the upper shell backward and forward across the inner surface of the lower shell to make a grating sound which experience has proved to be attractive to sharks.

When a shark is attracted by the sound, the stiff noose is placed over the side in the water. This procedure appears to be exactly the same as in Samoa (Hiroa, 4, p. 422). The noose is held open by one hand near the eye and the other hand holds the rope part. The shark, attracted by the bait, enters the loop and the fisherman, when he sees the dorsal fin (*taratua*) level with the noose, pulls the rope taut. The shark is thus caught behind the gills and there is no danger of the noose slipping forward over its nose. The shark, secured by the noose, is struck (*tariki*) on the head (*tiripoko*) with the rounded end of the shark killer.

The general name for sharks is *mango* and Tukohi divided them into four kinds (*hatunga*): *arawa, mochenua, tokouru,* and *rarai*.

The shark killer (*matako*) is a wooden bludgeon with a rounded end which is carried in the canoes for killing sharks as well as other large fish. Usually one end is sharpened to a flat point for husking coconuts for drinking at sea. (The nuts are steadied between the feet while the husking point is used.) A specimen made for the Museum (C.9989) by Poteke is 28 inches long and 1.7 inches in diameter at the thickest part, which is near the middle.

FISH TRAPS

Introduction

Fish traps, generically termed *u*, are in general use and numbers of them are to be seen in practically all the canoe houses, where they are kept on scaffoldings of poles placed across the tie beams and tie-beam plates, usually at the ends of the buildings. There are four types of traps, one with two varieties, and two varieties of containers for holding live fish bait and built on the same principles as the fish traps. All these articles bear the name of *u*, but are qualified according to their use. In their order of complexity of technique they are as follows: *u kiha kena*, *u hakapakipaki*, *u takape*, *u ta*, and *u kiha*.

The two varieties of live fish containers are: *u hakatari marau pungu* and *u hakatari kiha*.

All the traps and containers are made of a latticework frame of thin laths and rods, which are reinforced in places with stronger rods. The laths, which form an inner series, or layer, are made of split pandanus and *matira* (bamboo) and average 0.4 inch in width by 0.2 inch in thickness. The outer set of rods averages 0.5 inch in width and 0.4 inch in thickness, the lesser diameter being due to trimming the part to tie against the inner laths. The latticework is made separately for each wall or surface of the trap, and they are then assembled and lashed together. For descriptive purposes, it is convenient to treat the making of a trap as similar to the building of a house. The trap has a floor, two side walls, a back wall usually with the exit door, a front wall with a funnel entrance, and a roof, usually with a short projection at the front end to form an awning. Crossed diagonal rods (*tarahaki*) may be used to strengthen the floor, side walls, or end wall, and heavier battens may be used on the under side of the floor.

All traps have the laths and rods arranged in a similar manner. The laths are on the inner side and are directed lengthways in the floor and the roof and vertically on all the upright walls. As the rods on the outer side cross the laths at right angles, they are horizontal on the walls and transverse on the floor and the roof. The two sets are fastened together at their crossings with the crossed overhand lashing which is made on the outer side of the

rods and continues for the full length of the rod. Sometimes single diagonal knots are interspersed between the crossed knots (fig. 153). In some parts of the traps, vertical rods may be attached on the outer side of the horizontal rods or a longitudinal rod may be attached above the transverse rods on the roof. Such additions are placed opposite an inside lath running in the same direction. Such third additions do not interfere with the usual lashing technique, for the lashing turns simply pass around three pieces instead of two at the crossings. The same technique applies to the extra diagonal struts termed *tarahaki*, for they are laid in at the commencement and the lashing turns are passed around them at the points where they cross the outer rods. The cord used in the lashings is right-hand, two-ply coir cord.

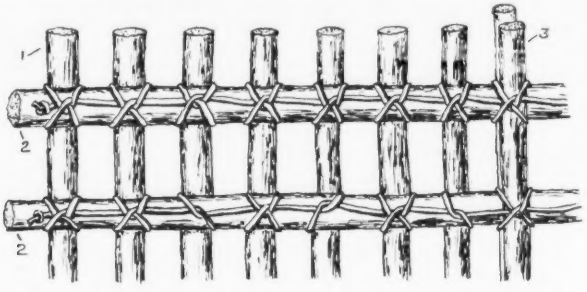

FIGURE 153.—Fish trap lashing technique: 1, inner vertical rods; 2, outer horizontal rods; 3, double vertical rods.

There are problems connected with joining the walls together, but these will be dealt with in the description of the simplest form of trap, the *u kiha kena*.

U KIHA KENA TRAPS

The *u kiha kena* is a small trap used to catch the small white sea eels (*kiha kena*) which frequent the rocks in the passages between the islands (fig. 154). Informants stated that they were used by young people who could readily set them in the pools when the tide was out and that it was good practice for them though they changed over to the large traps when they reached man's estate.

The type specimen in the Museum (C.10037) was collected in Werua. It is 19.5 inches long, 13.5 inches wide, and 8 inches high in the middle line at the ends. The height of the side walls being 5 inches, the roof is curved and projects forward 2.5 inches beyond the front wall.

The floor (fig. 154, *a*) is formed of thicker rods than those of the other parts. In the width of 13.5 inches there are 20 longitudinal pieces forming the inner or upper layer; and to the underside, in a length of 19.5 inches, are 18 cross rods. The crossings are lashed with the crossed overhand knots in continuous rows on the cross rods; but single overhand knots are used here and

there. On the inner surface above the longitudinal layer are two crossed diagonals extending to opposite corners. These are included in turns of the continuous lashing wherever they cross above a cross bar. On the under surface at the side and end borders, battens of coconut wood, 1 inch wide and 0.5 inch thick, are lashed on in three places to the floor above. These rest on the coral bottom and protect the bottom of the trap from undue wear.

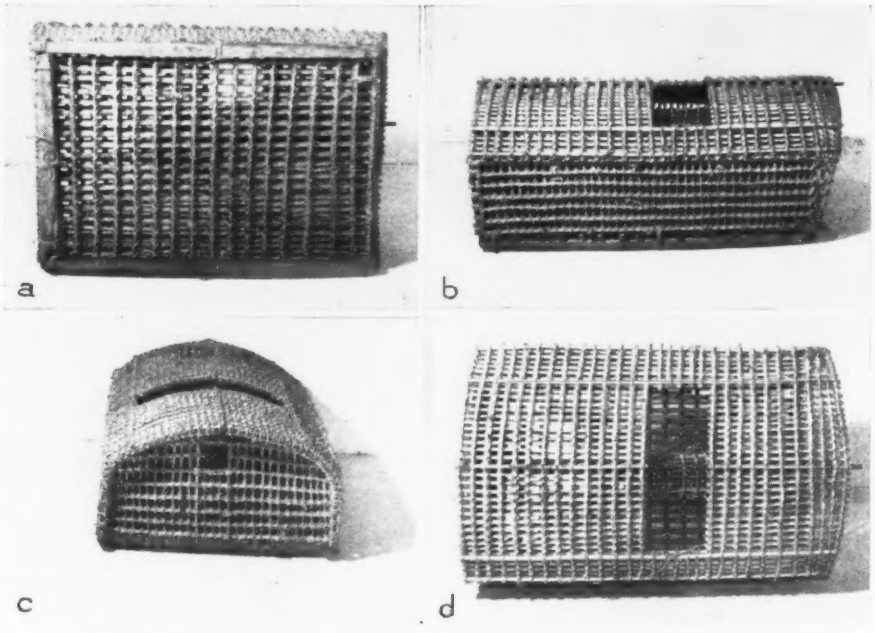

FIGURE 154.—*U kiha kena* trap: *a*, floor; *b*, side and roof; *c*, front and roof; *d*, roof.

The sides (fig. 154, *b*), 5 inches high, are formed of fine inner laths or rods set vertically less than half an inch apart. Seven outer horizontal rods are evenly spaced over a depth of 5 inches. At each end, a vertical rod is lashed on the outer side of the horizontal rods. Two crossed diagonals are attached on the inner side of the middle part of the wall, and the side floor batten is attached below. The forward end slopes upward and forward to comply with the forward projection of the roof.

The back end is formed like the sides but the upper edge rises in a convex curve to comply with the curve of the roof. Thus, the outer rods, which are horizontal up to the height of the side walls, are curved at the upper edge.

The front (fig. 154, *c*) is made like the back wall with an upper convex curve. Toward the top in the middle line is a square hole, 1.5 by 1.5 inches, for the funnel entrance. It is bounded on each side by a vertical rod which

extends the full height of the wall on the outer side of the cross bars. These verticals are included in the continuous lashing on the horizontal rods. The upper and lower borders of the square opening are formed by two ordinary cross bars, an intermediate one being cut out for the width required.

The roof (fig. 154, *c*, *d*) is convex from side to side. A ridgepole formed of dark coconut wood, 22.5 inches long and 0.35 inch thick, rests on the middle of the upper curved rods of the front and back walls and projects 2.5 inches beyond the front wall. Three transverse curved rafters are spaced evenly between the two ends. Their lower ends are tied to the inner side of the side walls and their midpoints to the under surface of the ridgepole by being included in the lashing on the outer transverse rods. The longitudinal inner rods rest on the three rafters and the curved rods of the back and front ends. The ridgepole is in the same layer as the longitudinal rods. The transverse outer rods cross from side to side and pass over the ridgepole to form a convex curve. The continuous, crossed overhand lashing is continued along the outer transverse rods. It does not include the three rafters, but it does include the ridgepole and another longitudinal rod laid above the transverse rods in the middle line. There are also outer longitudinal rods at each side edge and another about 2.5 inches above them.

The exit opening is made in the roof 5.5 inches back from the front wall. It is 3.5 inches wide from front to back, and the lateral length is 10 inches. The front and back edges are defined by crossing rods and the other edges by the outer longitudinal bars, which are 2.5 inches from the upper border of the sides. The main ridgepole crosses the opening but the longitudinal rod above it is cut off. The cover (*tai*), which is missing, was made exactly like the framework to fit over the opening. It rests in the middle on the ridgepole, and some of the outer rods are left long at each end to be inserted under the outer longitudinal rods which bound the opening, and so keep the cover in position (fig. 154, *d*).

The funnel is made of thin longitudinal rods, 12 inches long, which form into a tube by hoops of similar thin material which are spaced 0.75 inch apart. The longitudinal rods are spaced 0.25 inch apart and are lashed to the inner side of the hoops with the continuous crossed overhand technique used in the rest of the trap. The outer end of the funnel is 2 inches high and 2.5 inches wide, so that it overlaps the 1.5 inch square opening in the front wall. The hoop of the funnel opening is lashed to the inner side of the front wall by a separate cord which makes double overhand knots around the funnel hoop and the adjacent rods of the front wall. The long rods are brought closer together at the inner end to diminish slightly the size of the inner opening, which is bounded by two curved rods forming an upper and lower lip, as shown in figure 155. The horizontal width of the mouth opening is 2 inches, the vertical

depth in the middle line, 1 inch. With the trap in constant use, the lips of the funnel are pliable, and small sea eels readily push their way through. The lips close down after the passage of the eel, thus even if the eel finds the suspended opening, it is difficult, if not impossible, for him to squeeze through the narrow opening to escape.

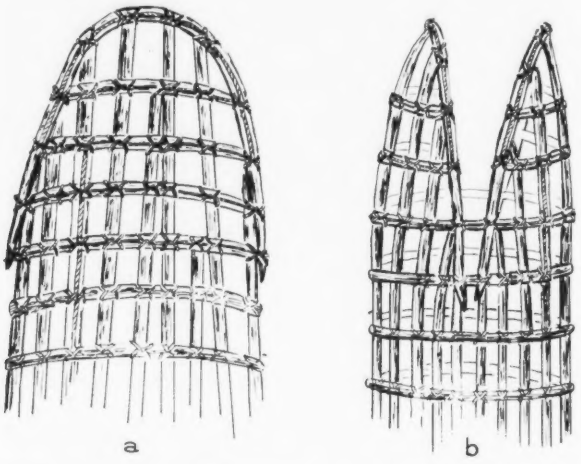

FIGURE 155.—Inner funnel opening: *a*, from above; *b*, side view.

The various sections of the trap are joined together by utilizing the continuous crossed lashing on the outer rods of one section to include the nearest rod of the other section. An exception to this rule occurs in the joining of the side walls to the floor. This is done by double overhand knots, 2.5 to 3 inches apart which pass around the lowest longitudinal rod of the wall and the outermost longitudinal rod of the floor (fig. 156, *a*, *b*, 1).

The back and front walls are lashed to the floor by single turns from the crossed lashing of the lowest transverse bar of the wall passing around the end transverse bar of the floor. Thus, the lowest transverse bar of the end walls is not lashed to the vertical rods until the wall is placed in position for lashing to the floor (fig. 156, *c*, *d*).

The side and end walls are lashed together at the vertical corner junctions by a continuation of the crossed lashings on the horizontal rods from either wall. At each corner is an outer vertical rod attached to the outer side of the horizontal rods of each of the walls, which are lashed in position by the crossed lashing on the horizontal bars. The ends of the horizontal bars from each side cross each other in the space between the two vertical rods, and the binding cord from one side passes around the crossed ends in a crossed overhand knot (fig. 156, *e*).

The roof is attached to the side walls by a continuation of the crossed lashing on the transverse rods of the roof. This lashing includes a longitudinal rod placed above the transverse rods, the marginal inner roof rod, and the uppermost longitudinal rod of the side walls. Both turns of the crossed lashing pass around the wall rod and firmly lash the outer edge of the roof to the upper edge of the side wall (fig. 156, *f*, *g*).

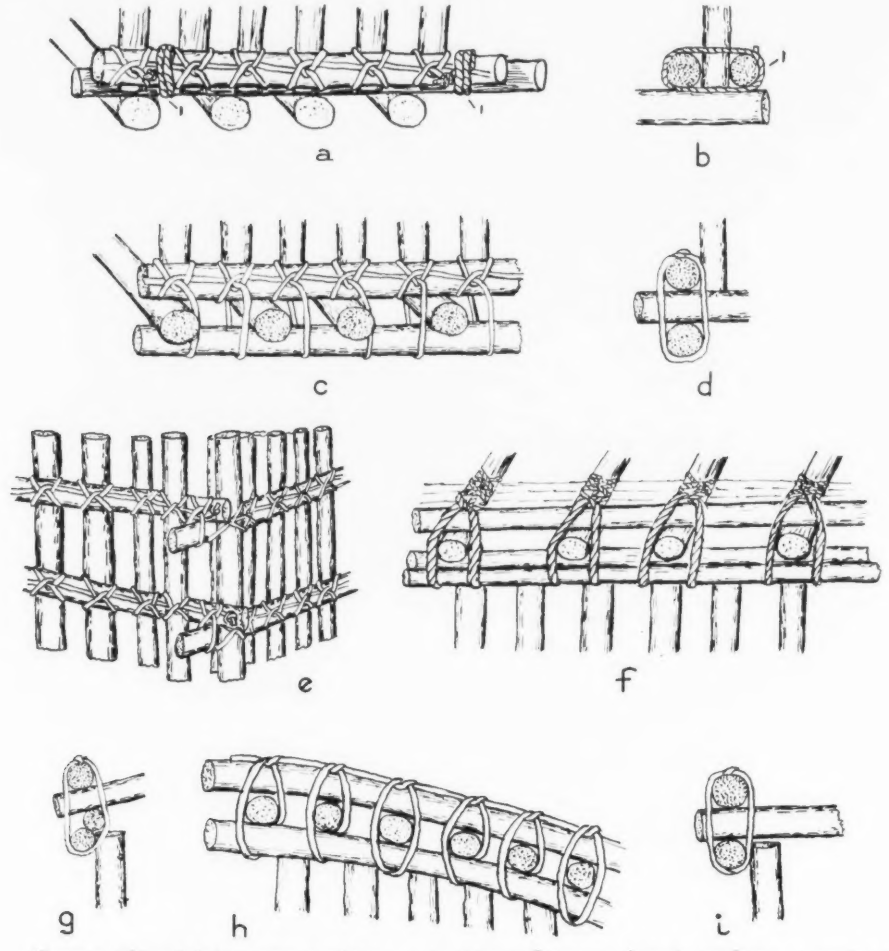

FIGURE 156.—Joining trap sections: *a*, *b*, side to floor; *c*, *d*, ends to floor; *e*, ends to sides; *f*, *g*, roof to side; *h*, *i*, roof to end.

The roof is fastened to the upper curved edges of the end walls in a manner similar to the lashing of the end walls to the floor. The crossed lashing which extends along the end transverse rod of the roof to fasten the longitudinal rods below also extends down to include the uppermost curved rod of the

end wall. Here, as with the floor, only one turn of the crossed overhand lashing is carried around the wall rod as a rule, but sometimes both turns are used. The upper curved rod of the wall has its own lashing with the inner vertical rods of the wall, but they are left out of the drawing to avoid confusion (fig. 156, *h*, *i*).

The funnel is lashed to the front wall before the roof is put on.

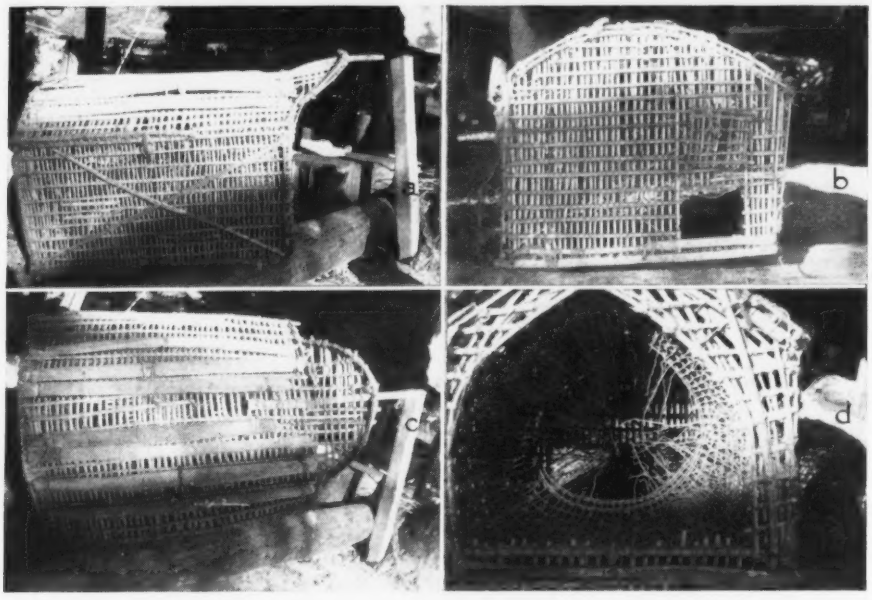

FIGURE 157.—*U hakapakipaki* trap: *a*, side with awning; *b*, back; *c*, roof and awning; *d*, front with funnel opening.

U HAKAPAKIPAKI TRAP

The *u hakapakipaki* receives its qualifying term from the operation of men beating the water (*hakapakipaki*) with poles or paddles as they drive the fish into a V-shaped race of nets leading to the trap. The trap is provided with a funnel-shaped entrance to prevent the fish from escaping. A trap examined in the Touhou men's house is herewith described according to its various surfaces (fig. 157, *a-d*).

The bottom is 2 feet 6 inches wide in front, 2 feet 10 inches at the back, and the sides are 3 feet 3 inches long. The inner laths are 32 in number, with a couple of short ones inserted in the wider, back end. The outer cross rods, which extend from side to side, number 17, and the laths are lashed to them by the continuous crossed overhand technique already described. The wood is *woroworo*.

The two sides (fig. 157, *a*) are, respectively, 3 feet 3 inches wide at the bottom, 3 feet 6 inches at the top, and 20.5 inches high. The inner vertical sticks are round in section and 0.3 inch in diameter. The wood, called *ngia*, is obtained from Nukuoro. They number 50 and are fastened to 11 evenly spaced horizontal rods by the crossed overhand technique. Two diagonal rods termed *tarahaki* extend between opposite corners and are tied at intervals to the horizontal rods. In two places, where an inner stick has been broken between the horizontal rods, a short horizontal piece has been lashed to the unbroken sticks on either side of the hole to cover it sufficiently for practical purposes.

The back wall (fig. 157, *b*) is 2 feet 11 inches wide at the bottom and 3 feet 2 inches wide at the height of the side walls. The arch of the roof gives an additional height of 9 inches in the middle line. An opening for extracting fish is located near the right lower corner, and it is 8 inches wide by 9 inches high. It has an outer threshold formed of a thicker rod, 16 inches long by 1.1 inches thick. The door is formed of a rectangular piece of latticework and both the door and the opening are termed *tai*.

The roof (fig. 157, *c*) is arched from side to side, and over the arch it measures 3 feet wide at the front and 3 feet 8 inches wide at the back. The inner laths, which follow the lateral curve of the roof, number 44. The outer longitudinal rods number 19, and the length of the roof from the front awning to the back wall is 3 feet 6 inches. Seven wider, pandanus and coconut wood stakes, trimmed to 4 inches in width, are lashed longitudinally at their ends to the rods beneath them. These larger stakes form a protective roof covering to support large pieces of coral placed on the roof to keep the trap down when in use. The roof is reinforced by two stout curved cross bars, one at the front end and one in the middle.

A curved awning (fig. 157, *a, c*), termed *rae* (forehead), is added to the roof by two arched rods which project forward from the roof. Its width is 2 feet 3 inches, and it projects forward 9.5 inches. The awning is given its upward slope by a middle, stouter rod which projects back on the main roof 8.5 inches. The longitudinal elements of the awning are formed by an unbroken continuation of the roof rods, and their outer ends are caught between two arched rods, one above the other. The two arched rods and the rod ends are lashed together. Transverse laths are attached to the rods in the usual way. The strong median rod, which is straight in its course on the roof is curved upward beyond. This median rod, termed the *rakau tua* (rod of the back), projects beyond the forward end of the awning for 6 inches and forms a convenient handle for lifting the trap. The awning-like projection is made for the purpose of lashing the two nets to the front of the trap when it is in use.

The front (fig. 157, *d*) of the trap is 2 feet 7.5 inches wide at the bottom and 2 feet 8 inches high in the middle. It consists mostly of the entrance open-

ing, with about 4 inches of wall surrounding the opening at the bottom and the sides.

The floor has diagonal cross pieces (*tarahaki*), and the roof has a strong rafter across the middle of the trap.

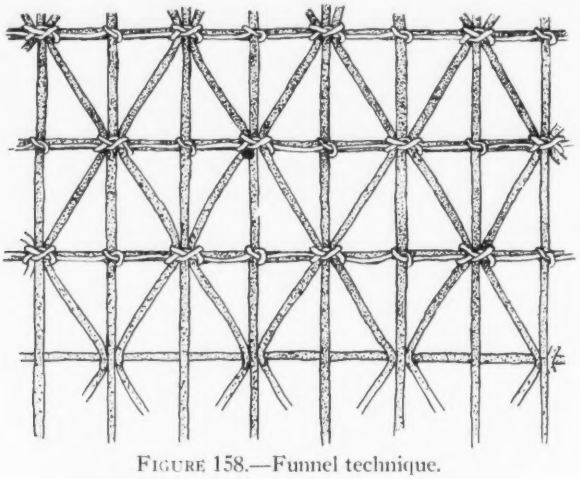

FIGURE 158.—Funnel technique.

The funnel (*matahanga*) is attached to the front opening, which is 26 inches wide and 20 inches high and is made of peeled coconut roots (*aka niu*). The funnel is composed of longitudinal warps about 32 inches long and a series of transverse hoops 1.25 to 1.5 inches apart which are lashed to the warps. From the outer hoop attached to the front opening, the hoops extend inward 13 inches, the innermost having a diameter of 16 inches. From the innermost hoop, the free ends of the warps extend inward 19 inches. The warps consist of alternate straight pieces an inch apart at the outer ends. Between them, another set zigzags from side to side and is tied to the straight warps at the hoop crossings, as shown in figure 158. The continuous lashing, termed *hiri,* is carried along the outer side of the hoops with crossed overhand knots around the triple junctions and a single turn around the straight warp crossings.

The joining of the walls follows the general technique of the *u kiha kena.* The method of using the trap has been described with the coir nets with which it is combined (fig. 135, *b*).

U TAKAPE TRAP

The *u takape* is a beautifully made trap composed of fine strips of pandanus or bamboo wood, tied together with the usual *hiri* lashing. It is rectangular in ground plan, with walls inclined outward, an arched roof, and a well-finished funnel entrance. A specimen examined is 30 inches long at the bottom and 36

inches long at the top with a front awning of 6 inches. The bottom width at both back and front is 28 inches. The front height is 24 inches, the back, 20 inches (fig. 159, *a, b*).

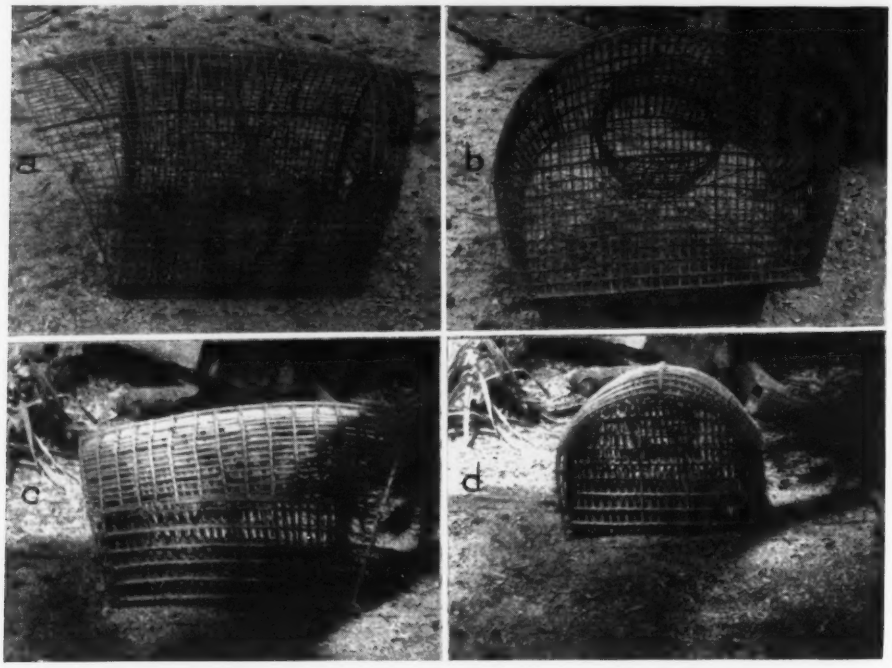

FIGURE 159.—Fish traps: *a, b*, the *u takape; c, d*, the *u ta.*

As the trap follows the general technique of the two already described, it would be repetitious to go into the details of the main parts. A special feature, however, is the use of five curved rods, including one at each end, evenly spaced along the length of the trap. They stretch from the bottom edge on one side with an outward slant, curve over the roof and slant inward to reach the bottom edge of the other side. They form combined wall posts and rafters to maintain the particular shape of the trap.

The entrance of the funnel (*matahanga u*), which abuts against the roof, is 9 inches high and 10 inches wide (fig. 159, *b*). The funnel itself is made of the usual longitudinal warps and transverse hoops evenly spaced. It is 14.5 inches long with the lower line perfectly horizontal. The hoops, however, gradually diminish in size to cause a downward slant of the upper surface for 10 inches. The upper warps are then turned down at a sharper angle to meet the lower horizontal warps and so close the inner end of the funnel. An opening, 5 inches long and 4 inches wide is made on the under surface of the funnel close to the inner end. The exit opening is in the back wall.

Another feature is a thick horizontal rod which rests on the top of the five curved rods and so forms a strong ridgepole to which a rope is tied when using the trap.

In use, the trap is baited and lowered to the bottom of the lagoon by the rope tied to the ridgepole. It is set as deep as 30 to 40 fathoms. The canoe remains over the spot and the trap is hauled up every 20 minutes or more. The routine is continued for as long as fish are caught but if unsuccessful, the fisherman moves on to try other places.

U Ta Trap

The *u ta* is built on the same plan as the *u takape* but is larger, with framework of stout sticks instead of split laths and thin rods.

A trap examined at Werua is 36 inches long at the bottom and 47 inches at the top, including an awning projection of 11 inches. Its width is 35 inches at each end. The height is 29 inches in front and 23 inches at the back. The funnel structure and position are exactly the same as in the *u takape*, and other details are similar (fig. 159, *c*, *d*).

It is used in the same way as the *u takape* but is so strong that the fishes caught, such as *urahi*, *pongopongo*, and *taratea*, can be kept alive in it in the lagoon for bait or for future eating.

U Kiha Trap

The *u kiha* is a baited self-acting trap for catching sea eels (*kiha*), which are fat and greatly esteemed. It is bluntly elliptical in ground plan with a flat bottom and an arched roof which slopes both transversely and longitudinally. It is made of a latticework of inner split laths and outer rods which are tied at their crossings with the typical *hiri* lashing.

A typical specimen examined at Werua is 36 inches long in the middle line at the bottom and 48 inches over the curved roof. The sides (fig. 160, *a*), which slope slightly outward, are 8.5 inches high at one convex end and 9 inches at the other. The bottom width at the middle is 20 inches and at the top of the walls, 23 inches, thus showing the slight outward inclination.

On the under surface (fig. 160, *b*) four stout battens, termed *takaheke*, lashed longitudinally to the bottom frame, project 6 inches at each end and so protect the under surface of the trap from wear against the coral bottom when the trap is set. In the middle of the two sides (fig. 160, *a*), two V-shaped pieces of wood are lashed with their apices toward each other. The ends, which point upward and downward, are free and serve as cleats by which pieces of coral are lashed on with diagonal turns around the ends and finished off with some circumferential turns. The rocks on either side serve as both sinkers and anchors and are attached only when the trap is to be set.

The roof (fig. 160, *c*) is curved convexly in both directions and has a middle transverse section which is detachable as a lid (*tai*). It is 5 inches wide and

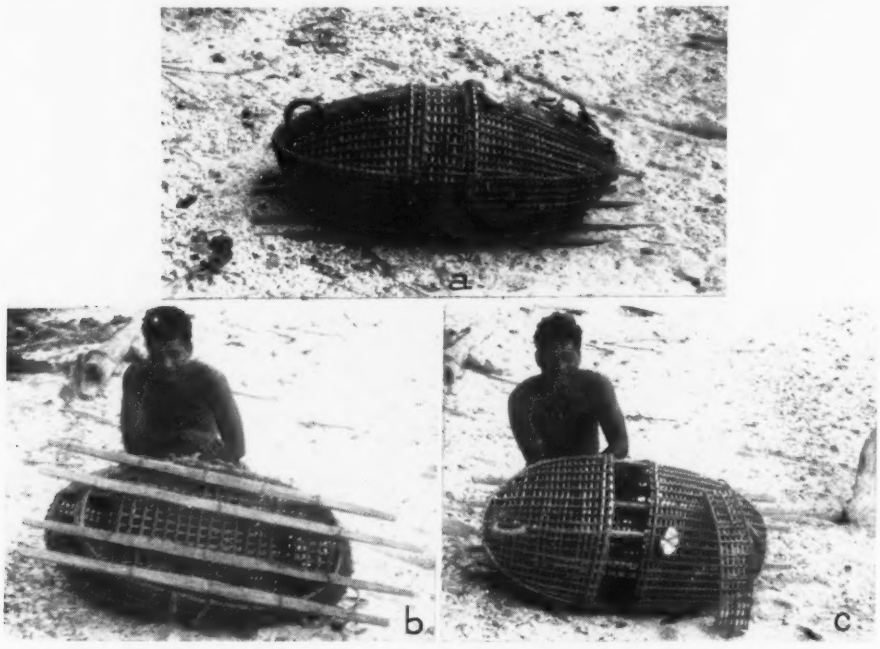

FIGURE 160.—*U kiha* trap: *a*, side and roof; *b*, bottom; *c*, roof.

extends the whole curved width of the roof. A median longitudinal rod serves as a ridgepole (*tahuhu u*), and the lid section as well as the other parts of the roof rest on it. The lid is composed of eight long curved laths, and short cross rods are attached to it with the *hiri* lashing in the same way as the rest of the roof. Four of the long laths which project beyond the end cross bars are inserted under the top horizontal bars of the sides to lock the lid in position. At each end of the lid, two crossed diagonal sticks, termed *tarahaki*, strengthen the ends of the lid. On one side of the lid opening, a Tridacna shell with its inner surface uppermost is lashed to the roof framework with the branched, seized lashing termed *mataha mangarua*. On the other side of the opening near the end, a strong well-seized loop is attached to the framework.

The interior arrangement of the trap forms a kind of labyrinth through which the entering eel can move only in one direction. The various parts are shown in figure 161, *a*, *b*, and described as follows.

The ground plan *a* shows the circumferential bottom loop (1), two vertical side walls (2), and three cross partitions (3, 4, 5). The vertical side walls extend from the bottom to the roof and are made with the same technique as the rest of the trap. They

extend a short distance beyond half way and are closed at their ends by a partition (5). The middle compartment so formed is 7.5 inches wide and the two side compartments at the widest part of the trap are 6 and 6.5 inches wide, respectively. The two side compartments meet around the end of the middle compartment.

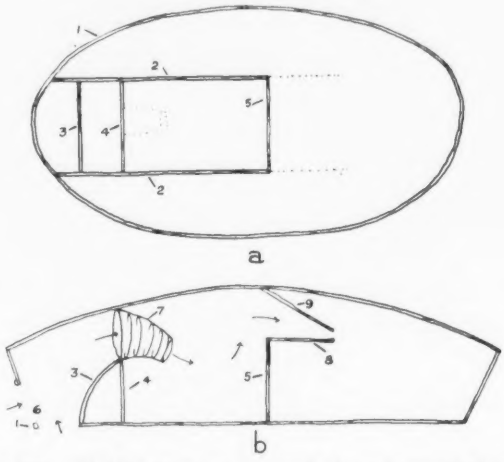

FIGURE 161.—*U kiha* trap: *a*, ground plan; *b*, vertical section.

The vertical section along the median line (*b*) shows the trap entrance (6) which is formed by an opening 4 inches square on the floor and a similar opening beside it on the end wall. The entrance leads into the middle compartment and is crossed by the circumferential hoop (1). On the inner side of the bottom opening, a partition (3) extends across the middle compartment and curves inward for 4 inches to meet the vertical cross section (4) which is 5.5 inches high. To the rectangular opening above the partition, the outer hoop of a short funnel (7) with a downward curve is attached. The funnel is formed of warps and hoops but the warps do not project beyond the end hoop. The hoops gradually diminish in size so the inner end is free of contact with the walls and roof. The end partition (5), which closes the ends of the side walls, is 7 inches high. From the upper end of the partition, a horizontal platform (8) is carried forward for a few inches, leaving a rectangular opening 5 inches high above the partition. The opening is closed by an inclined partition (9) sloping down from the roof toward the end of the horizontal part (8), but leaving a narrow horizontal slit between the forward edges through which an eel may push its way.

The trap is baited with *marau* or other fish which have the backbones removed and are tied down to the floor of the side compartments with strips of pandanus aerial rootlets. Attracted by the bait, the eel enters the middle compartment and passes through the two funnels, rendering its return impossible.

A short length of rope is tied to the seized loop on the roof and to the other end of the trap. The trap is set in the lagoon or on the outer slope of the reef at a depth of 10 to 15 fathoms and left without a float. It is relocated by the white Tridacna shell lashed to the roof. The fisherman dives down, ties a rope to the rope loop on the roof, regains his canoe, and draws the trap up into it.

U Marau Pungu Bait Container

The *u marau pungu* or, to give the full name, the *u hakatari marau pungu,* though bearing the generic name of *u* is not a trap but a container for keeping (*hakatari*) live bait, of which the most common is the red fish named *marau pungu.*

A typical specimen (fig. 162, *a*) in the Touhou men's house is perfectly rectangular with a slightly hipped roof. The sides are 28 inches long, the ends 16 inches wide, the height of the walls 8 inches and the roof, in the middle line, 11 inches high, showing a roof elevation of 3 inches. The wood is of split bamboo laths.

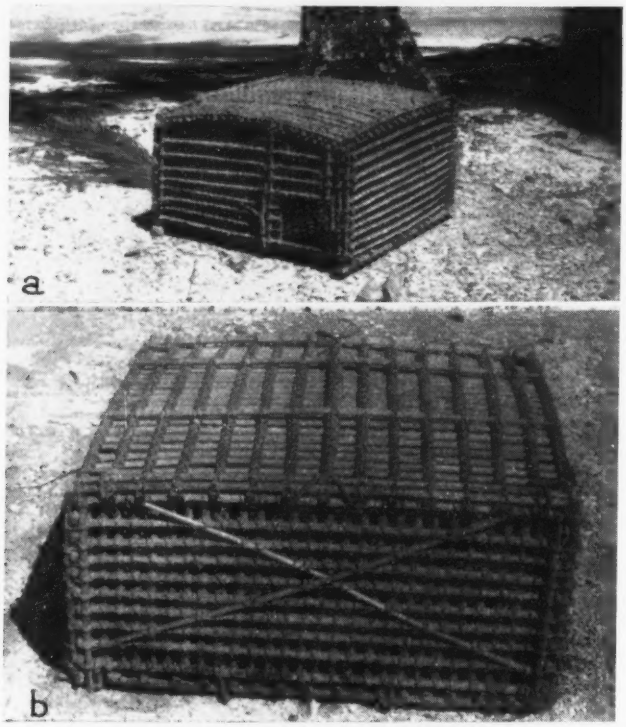

Figure 162.—Fish containers: *a*, the *u marau pungu; b*, the *u hakatari kiha.*

The technique of the framework is identical with that of the *u hakapakipaki* trap, but it is more stoutly built and has no entrance funnel or porch. A rectangular opening, 6 inches square, with the characteristic cover, is formed at one end wall at a lower corner. Though the details of the various walls, floor, and roof have been recorded, they are so similar to those of the traps described, that it would be repetitious to describe them here.

The bait container is a useful part of a fisherman's equipment for preserving live bait until he is ready to sail out beyond the reef to angle for deep sea fish.

U Hakatari Kiha Container

The *u hakatari kiha* (fig. 162, *b*) is a larger and stronger container than that just described. One examined at Taringa has the following dimensions: length, 37 inches; width, 23.5 inches; back height, 19.5 inches; front height, 20.5 inches; door, 7 inches square.

The technique is the same as for the trap but without the entrance funnel and awning. It is the general similarity of technique that has led to the inclusion of containers under the trap name of *u*.

The larger container is not used for live bait but to keep large fish such as the sea eel (*kiha*) alive and in reserve until the family is ready to serve them.

Mat Trap

The *kahara kupe* is a primitive, makeshift trap made of a pandanus mat (*kahara*) and used to catch small fish (*kupe*) for bait. A specimen made for Bishop Museum by King David had been a pandanus mat 35 inches long and 18.5 inches wide, plaited from pandanus leaves which had dried naturally on the tree, hence brown in color. The plaiting is in check with wide wefts, 2.5 to the inch. The mat is doubled on its long length, and the free ends are sewn together, as is one side. The sewing is done with a piece of coconut-leaf midrib as a needle and a two-ply, left-hand coir cord as the thread. A wide running stitch is started at the top of one end and then continued across the bottom. A bag is thus formed which is 17.5 inches wide and 18.5 inches deep.

Fishermen staying for the night at one of the outer islands usually have some pandanus mats to rest on. Failing a better form of net, one of the mats is readily formed into a temporary bag receptacle, such as described above, and used to catch small fish for bait. The bag is laid in the shallow bottom and stones placed in its bottom to keep it anchored. The mouth is opened, and a fisherman sits behind the improvised trap. His companions drive the small fish into the trap from either side and the front. When fish enter, the fisherman behind the trap presses down the upper flap and encloses the fish. When the trap is no longer needed, the stitches are removed and the mat spread out to dry. To facilitate removal of the stitches, the sewing usually ends in a slipknot.

Child's Coconut-shell Trap

The child's fish trap (*urutahi*) was made of a green coconut shell with the eye end cut off evenly beyond the middle and holes bored around the rim with a sharp stick or a shark's tooth. The holes were close together, and threads of

coconut fiber (*moi kaka*) were crossed in a square mesh, a square hole being left in the center for small fish to enter. Hermit crabs were chewed (*mama*) and placed within for bait.

The baited trap was set in pools of the channels between the islands. The children watched and when a fish entered, they chanted:

> Uru tahi mo kai kara, ka kai tama kiki.
> One enters to provide delicious food that little children will eat.

As other fish entered, the children chanted:

> Uru tahi, uru rua, uru toru, uru ha.
> One enters, two enter, three enter, four enter.

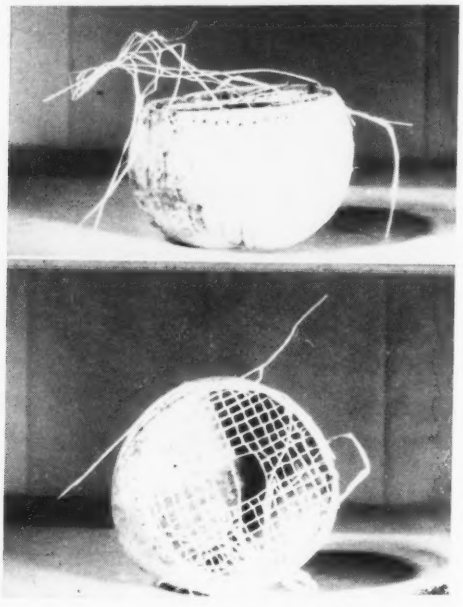

FIGURE 163.—Coconut-shell trap.

When the fourth fish entered, the child in charge of the trap quickly placed a hand over the entrance hole. The fish caught were "delicious food (*kai kara*) for the little children (*tama kiki*)." In later years, a door (*ponotai*) was fixed with a loop hinge to one side of the entrance and a long string attached to the raised side was pulled to close the door. When children had pet birds, such as the young of the *tahongo* (sooty tern) and *terekia* (noddy tern), they fed them with the small fish caught in their traps.

A model of the trap (C.9988) was made for us by King David from a mature coconut shell (fig. 163). The holes were bored with a metal drill and

the crossing threads were obtained from the prepared strips of coconut leaves used in making trade belts.

FISH WEIRS

Fish weirs (*awa*) were formerly next in importance to nets, traps, and hooks. They were erected from the coral rocks (*hatu*) so plentifully scattered over the tidal passages between the islands. One, between Touhou and Taringa, is in fair repair. The stone walls are about the height of water level at high tide. Two walls are inclined toward each other to form a V-shaped race with an opening at the angle. The passage between the walls is termed the *awa* (channel) and gives the name to the weir. Weirs were sometimes used to catch *tauwene*, and a fisherman closed the opening with a *tae tauwene* net. The *hakapakipaki* method of beating the water with poles to drive fish into the race was adopted in connection with the set net at the opening. In one weir examined, a smaller V-shaped weir with an opening was set within a larger weir. One arm of the smaller weir reached an arm of the larger one, the angles of the two being set in opposite directions, that of the larger weir being closed. Fish were driven into the larger weir, where they turned at the closed angle back along the two arms which met and went into the smaller weir and were caught in a set net or trap at the V-opening.

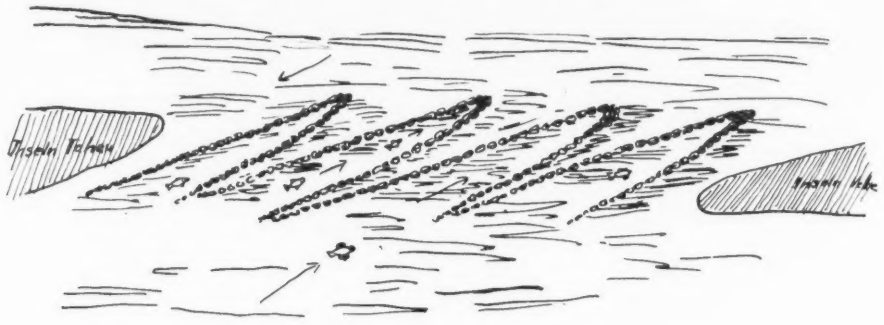

FIGURE 164.—Fish weirs, after Eilers.

A series of seven weirs in the channel between Touhou and Werua were figured by Eilers (2, p. 90). The angles of the walls were so placed that the apex pointed alternately to the open sea and to the lagoon (fig. 164). Thus, fish coming in from the sea with the rising tide were caught in one set of weirs and fish going out from the lagoon with the falling tide were caught in the other set.

GROPING

The process of groping for fish around rocks and in crevices and passages is termed *haha*, a widely spread Polynesian word with the same meaning. A

Polynesian cannot pass an outcrop of rocks in the lagoon without diving down and exploring the cracks and crevices with his hands. Rock-frequenting fish are driven into the ends of blind passages and caught by hand. It is the most primitive way of catching fish, and only those who are perfectly at home in the water can use it with success. It has its dangers, for sea eels are fiercely aggressive.

The groping method is the only one for catching crayfish (*ura*), for Kapingamarangi, which has so many types of fish traps, does not have one for *ura*.

Lathrop and I were able to watch a small party apply the groping method to crayfish. Led by Siro, who was an expert in catching crayfish, our party sailed by canoe to the open reef beyond Torongahae, the last island on the northern side of the reef. We landed on the lagoon side of the reef, tied the canoe to a block of coral, and met Tahiraropo, the local expert who knew the places most frequented by crayfish. The tide was out and the reef well-exposed, its wide surface strewn with large lumps of coral. Toward the sea, the reef surface was smooth, for the action of the waves and the tides had swept the detached pieces of coral farther in toward the lagoon. Along the outer slope of the reef and constantly washed by the sea were large flat masses of coral, reddish on the outer surface, full of recesses and passages in which crayfish took up their abode. This growing coral is termed *mataurnuru* and larger masses farther out are termed *tohoro*. The whole of the reef inland from the sea is termed *ti papa* (the *papa*) or *kono papa*.

The only equipment needed was the arms of our friends, but we carried a sack to receive the catch. Operations commenced with Siro and his two companions groping in the recesses and passages in the *mataurnuru* outcrop of coral. The crayfish retreated when touched until they were jammed against a blind end. It took some maneuvering to get the fingers around the body of a crayfish, but once a grip was procured, the crayfish was drawn out. Sometimes the passages had more than one exit and then teamwork was employed to block the passages with waiting hands. When a passage was a little too deep for a groper to grasp the crayfish, he withdrew his arm and broke down the edge of the passage by pounding it with a large block of coral. If a crayfish was seen escaping through an unblocked passage, the fisherman, with a yell, followed it to another mass of coral. This mass was investigated and its passages groped until the crayfish was located and captured. Our sack filled, Siro carried it lagoonward to the dry part of the reef and built a cache out of coral blocks to imprison the 16 crayfish caught. We worked steadily along the reef with continued success. But larger waves began to roll in from the sea, and often a man with his arm at full length up a hole and lying stretched out at full length on his side to get an extra inch of reach, would be swept over and lifted by a wave. However, he remained anchored to the rock by his arm. It was

strenuous work and I wondered that none of the three men was cut by the coral. When the bag filled with 18 more crayfish we made another cache. After another cache of 18 we decided to give up, as the seas were increasing in violence and the total of 52 crayfish was sufficient to supply our friends. The crayfish seemed to be of two varieties; greenish, light colored ones (*ura me*) and black ones (*ura uri*).

We picked up the catches with the sack and made three trips with it to our canoe. On arrival at Touhou, the catch was spread out on the ground before our quarters and we left the distribution to Siro and King David. That evening we dined on grilled crayfish cooked by a native chef.

FISH SPEARS

Fish spears (*marei*) were not seen in use during our visit, and I was surprised at the absence of the many-pronged iron spear now so much in use in parts of Polynesia. However, spears made of coconut wood were used in former times. Eilers (2, p. 81) states that they were not sharpened until just before use because the people were afraid of accidents or misuse of them. My informants said that they were two arm spans long and were hurled (*taro*) from a canoe at fish which came within throwing range.

The short spear used around coral heads is held to be a late usage rendered possible by the water goggles which every fisherman now possesses. An iron spear is termed *amu*, iron itself, *paranga*. The many-pointed spear, though not seen, is termed *taro mangamanga* (*mangamanga*, branched). In Nukuoro, the long single-pointed spear is termed *werowero*, from the verb *wero*, to thrust.

BOW AND ARROW

The bow and arrow (*marei tokopi*) were formerly used to catch fish. The bow was made of hau or *woroworo* and was 3 to 4 feet long. The bowstring was a length of fishing line (*uka*) or a cord of breadfruit bast. Eilers (2, p. 81) states that the bow as well as the arrows were made of "*niia*" wood.

Arrows were also made of hau in Alfred Patterson's time, and these were pointed with pieces of wire. He did not know how they were pointed in olden times. He had used the bow and arrow in his youth to shoot at fish near the shore. This was a sport of boys and adolescents, and Alfred dismissed its general use by saying that adults had better methods of procuring fish.

GAMES AND RECREATIONS

At the time of the Bishop Museum Expedition, games and recreations among the adult population were curiously lacking. However, Eilers (2, pp. 66, 67) evidently found a different atmosphere 40 years ago. He states that the

people frequently got together for common enterprises and that the most popular were games, particularly string figures and merry dances in which the entire population participated. Moonlight nights were favored at a place near the shore. Young people amused themselves, and they enjoyed lighting fires on stone heaps and tossing burning logs into the air so that the flying sparks lighted up the night like fireworks. The dancers and the onlookers sang to beat time, for they had no musical instruments. A strict dancing order existed only with certain dances. As a rule, young and old, men and women, women and girls mingled freely. Men, on the whole, were less inclined to dancing; the older ones sat as onlookers, talking, smoking, and criticizing. Swimming in the lagoon was also popular, particularly on bright moonlight nights.

It appears that a change took place after the acceptance of Christianity. Apparently the village elders discouraged dancing and hymns took the place of the old native songs. However, many of the older men and women knew quite a number of old songs and chants. At first they were not enthusiastic about imparting them to us, but King David was prevailed upon to recite an old chant and story for the wire recorder. When it was played back to him, he was delighted with the sound of his own voice coming from a machine. Others grew interested when we convinced them that the old songs and chants were an important part of their culture and should be recorded. We were able to install electric lights in an open space among the coconut trees and give evening concerts with the wire recorder. The concerts became popular, and practically the whole population attended them. The program increased in length and variety as volunteers came forward with tales and songs learned in their youth.

Some of the native dances were demonstrated by young adolescents; but, probably through lack of practice, they were lacking in variety of movement. The main movement consisted of swinging the arms backward and forward in time to a chant.

Of introduced games, groups of women played a card game with much vigor, dashing down the winning card with loud exclamations of triumph. Baseball has become popular with the older children, but the island of Touhou is so thickly covered with houses and coconut, breadfruit, and pandanus trees that there is no clear ground available for a full-sized baseball field. The game is played in a small area between the coconut trees and on a small strip of sandy beach on the ocean side of the island. Any stout stick serves as a bat, and the ball of pandanus leaf or coconut husk often comes to pieces during the game.

Meager notes were obtained about the games and recreations of children in which a few material objects were used.

OBJECTS USED IN GAMES

Stilts

Children frequently use stilts, which consist merely of poles with a cross stick tied on to form the step. There appears to be no specific name, and Patterson has heard them spoken of only as *rakau hahaere* (sticks for walking with).

Coconut Shoes

Coconut shoes are half coconut shells made from the end toward the stalk with a string through the punctured eyes. They are frequently seen in use. The children stand on the convex side with the string passing between the big and second toes and stump about on them. They are alluded to as *ipu hahaere,* which, like the name for stilts, is merely descriptive.

Hoops

Hoops, termed *tuatika,* are made of a flexible rod bent into a circle with the ends tied together. These are thrown so as to roll along the village road, the act of throwing being termed *hutuhutu.* One seen in use was about a foot in diameter, and the child rolled it along the road with a sequence of throws.

A smaller hoop, termed *sakioi* is used by smaller children.

Pandanus Hydroplane

A toy termed *ti mangi* was formerly made of pandanus leaf. It was placed on the water during a wind and, according to informants, the wind raised it off the water like a hydroplane. No details were obtained.

Skipping Rope

A thee-ply braid of strips of pandanus leaf, usually of the *pacho* variety, is used as a skipping rope. One specimen seen was 1 inch wide and 0.7 inch thick. Strips of hau bast are also used to make the rope. Both forms of rope are termed *ti kari paho,* also applied to the form of skipping.

The word *paho* is a shortened form of *pacho,* a variety of species of pandanus with wide leaves said to have been on the atoll when the ancestor Utumatua landed. According to Patterson, the term *kari pacho* was applied to the braided rope made from the leaves, but children have come to pronounce it as *kiri paho.*

Swings

Swings are made of hau bast, which is hung over a tree limb and the ends knotted together to form a loop in which the child sits. The swing is

usually put up near some raised object from which the child swings out. The only name given us was *ti kari paho*, which also applies to the skipping rope.

Pandanus Ball

A ball, called *parc*, is made of strips of pandanus leaf plaited in check in a cubical form and stuffed with bits of pandanus leaf. A specimen made for the Museum (C.10041) is 4.25 inches square. Eilers (2, p. 125) describes one as "a disc-shaped ball" made of pandanus leaves as a toy. They were probably thrown and caught formerly, but in modern times they may be used in the improvisation of baseball.

String Figures

String figures, termed *tuvanapeti*, though evidently not so popular now as during Eilers' visit, are still known to adults and children. We did not see any until after we asked about them. Then even small children showed us they could make them, and they became popular among the children for quite a time. But time was short and crowded with other things, so the subject of string figures was not pursued.

ORNAMENTS AND PERSONAL DECORATION

Ornaments of native manufacture are scarce, and little information can be obtained as to what was made in the past. Now, flowers are worn in the hair and also in the ears.

EAR ORNAMENTS

Ears (*taringa*) are pierced (*tui*) with the scraped barb of a sting ray (*hai*). Flowers for ear ornaments are termed *akai*, and Hetata listed the following as being worn in the ears. The term *mata* evidently refers to the flower.

Mata hereheu
Hingara (pandanus flower)
Mata pua
Mata hoehoe
Mata hia
Mata keinga (a grass)
Pangai (petals of *hetau*)
Tuangaungau (*ape* flower)
Mata woroworo
Mata ratara (spider lily, introduced)
Akai rakau (plumeria, introduced)

HEAD BANDS

Head bands are narrow circlets of pandanus leaf with flowers tied to them. They are worn by women and adolescent males who probably receive them from their sweethearts. The list of flowers used as *akai* ear ornaments applies equally well to the head bands. They are not permanent ornaments and are cast aside when the flowers fade. Eilers (2, p. 119) refers to these headdresses as *ti hau*.

Eilers (2, pp. 118, 119) describes a head ring as being made of several pieces of plant pulp wrapped up in a pandanus or banana leaf, the whole tied with hibiscus, coconut, or banana fibers and with the ends often reinforced to stick out. We saw nothing which corresponded to this description.

Eilers (2, p. 118) also states that shells were seldom used for head rings. But matters have changed, due to trade influence and the acquisition of finer drills for more readily boring holes in shells. Shell head bands now figure prominently in the handcrafts made for sale. The shells used are small white and colored cowries and small white Turbo shells. These are bored with a single hole near the lip of the shell opening and are spaced in a single row along the middle of narrow circular bands of pandanus leaf or thin pliable wood, 0.25 to 0.5 inch wide. Turbo shells when used with pandanus bands are placed closely together and stitched to the band with a strong thread, the shell projecting from the band at an even angle. With bands of wood, the thread is looped through the cowrie shell opening and the pierced hole. The shells are spaced less than an inch apart along a continuous thread. The thread is laid along the middle of the band and kept in position by a narrow strip of dyed *puraka* skin which is wound spirally over the thread between the shells for one length of the band and then turned back to cross over its first course in the shell intervals. A second thread is passed around the attached base of the shell and then through the shell opening and the hole, to continue to the next shell. The function of the second thread is to fix the shells in an even, slanting position from the band. The pandanus leaf band is also covered with crossing strips of dyed *puraka* skin, and a rosette of colored bast fiber or *puraka* skin is attached as further ornamentation.

NECK ORNAMENTS

We were fortunate in obtaining three apparently old forms of shell ornaments. A shell ring (C.10117), cut evidently from some cone shell, is a perfect circle with a portion of a whorl projecting on the outer side (fig. 165, *a*). The outer diameter of the ring is 1.6 inches, 1.7 inches across the outer projection. The shell is 0.4 inch wide and 0.25 inch thick. It may have been used as an ear ornament, but no information was obtained.

A shell pendant (C.10124) is made from a section of a reddish marine shell. One end is 0.45 inch wide, expanding to 0.7 inch and then diminishing to a sharp point, the length between the curved ends being 2.6 inches. The shell is 0.25 inch thick, and the broad end is perforated with a hole bored from the front back which is funnel-shaped from the outer convex side. The ornament is deeply curved (fig. 165, *b*).

A necklace (C.10123) consists of nine pendants shaped like the shanks of bonito hooks and one small piece of different shape. The nine long pendants

are all made of a dull white shell, apparently Tridacna, and range in length from 2.2 inches to 3.0 inches. The longest pendant (fig. 165, *c*) is 0.5 inch at its greatest width and the thickest part at the head is 0.4 inch. The head is shaped like a typical bonito hook with two lateral planes meeting to form a short median edge. A transverse hole is bored through the head below the meeting of the two lateral surfaces with the anterior surface which is narrower than the back, forms a plane slanting evenly to the distal end, and meets the lateral surfaces in distinct longitudinal edges which are slightly rounded. The back surface is flat throughout and forms sharp longitudinal edges with the lateral surfaces. The lateral surfaces diminish gradually in width from the head to the distal end, which is 0.2 inch thick. All nine pendants have similarly shaped heads, and in none of them does the distal end show signs of grooving or any other indication that a hook point was ever attached to them. It is evident that they are purely ornamental.

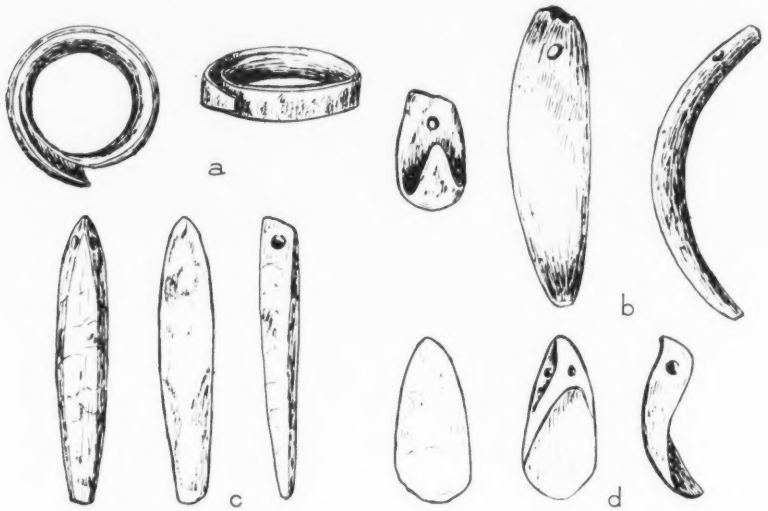

FIGURE 165.—Shell ornaments: *a*, ring; *b-d*, pendants.

The small ornament (fig. 165, *d*) is 1.3 inches long and 0.6 inch wide at its widest part. It is made of pearl shell, and it is evident that a part of the hinge provided the thickness to form a head with a median edge and a transverse hole.

The 10 pendants were originally spaced on an old cord; but, unfortunately, the donor removed the old cord and put in a new one before he presented the necklace to us. The new cord is a two-ply thin cord of hau bast which is knotted with an overhand knot on each side of the hole in each pendant to fix them in a permanent position on the neck cord at an average distance of 2 inches apart. The specimen, worn by King David, is shown in figure 3, *a*.

BELTS

Ornamental belts were rare when the German expedition visited the atoll (Eilers, 2, p. 109), but many are now made for trade. The pattern is said to have been copied from Marshall Islands belts which were shown to the people by the Island Trading Company to stimulate the manufacture of handcrafts. The people have become so expert that the market is glutted at times. During my first night at Kapingamarangi, I saw a light burning in a neighboring house and two men busily engaged in making something, and every time I awoke the light was burning and the men employed. It turned out that they were making ornamental belts in order to have them ready for sale the next day to the representative of the Island Trading Company. The belts are made of strips of pandanus leaf which are covered with narrow strips of specially prepared coconut leaflets and ornamented with the dyed outer skin of *puraka* stalks and small marine shells. Both men and women make the belts, but the women prepare the coconut leaflets and the *puraka* skin.

The coconut leaflets are selected from the central young leaf termed *tira*. They are split at the tip ends on either side of the leaflet midrib and pulled downward to separate the two sides from it, then jerked off from their attachment to the leaf midrib. The under part of the leaflet strip is then separated from the upper layer by pulling the strip across the edge of a knife. The upper surface strips are boiled and then hung over a line to dry. When dry, they are bleached and the edges are curled in. The curled strips are scraped with a knife to open them out flat before splitting them into narrow wefts about 3 mm. wide.

The long *puraka* stalks are cut into lengths, split open, and the inner porous material is scraped away from the skin, which is dried and colored with various trade dyes, there being no native dyes. When colored, the strips assume a shiny appearance, and people ignorant of the technique, mistake the material for trade ribbon.

The pandanus leaf is prepared as it is for making mats and split into three strips: a middle piece about 1.25 inches wide and two side pieces each 0.25 inch wide. They are doubled into lengths ranging from 26.5 inches to 28.5 inches, the doubling over being done at each end so that the exposed ends are folded. A third strip is added to each of the doubled pieces but they are cut shorter so as not to show at the folded ends. The pandanus foundation thus consists of three thicknesses.

The three triple lengths of pandanus leaf are laid side by side with the ends toward the worker. A strip of dyed *puraka* skin of the same width as the middle pandanus strip is laid over the middle pandanus strip with the near end overlapping the pandanus. Three strips of coconut leaflet are used to commence the binding of the pandanus strips; one piece (warp) to make close transverse

turns around the three pandanus strips and two pieces (wefts) to bind the transverse turns of the warp in the intervals between the middle piece and the two side pieces. The technique is shown in figure 166, *a-f*, and described as follows:

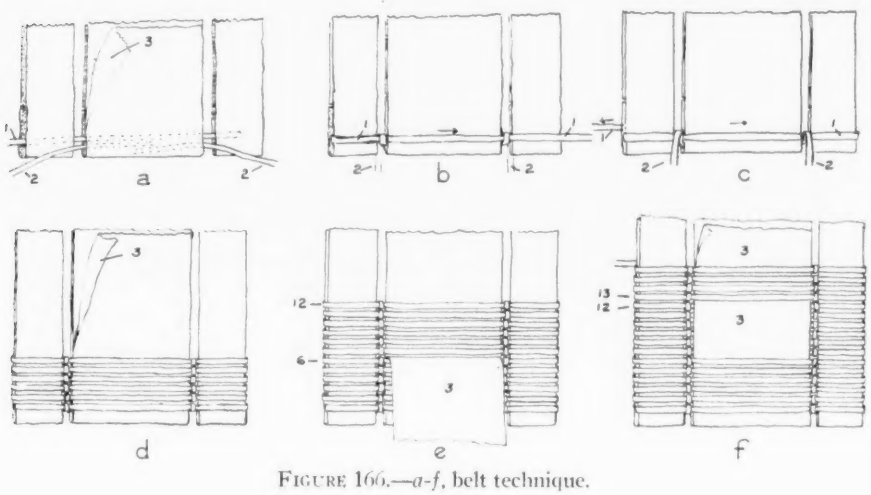

FIGURE 166.—*a-f*, belt technique.

The end of the warp (1) shown in *a* is passed horizontally from the left between the folded double strips, and the two wefts (2) are treated in a similar way at each of the intervals. The dyed *puraka* strip (3) has a corner turned back to show that it is lying on the middle pandanus strip. In *b*, the warp (1) is passed horizontally to the right and each weft (2) is passed over it in its respective interspace and drawn down at the back. In *c*, the warp (1) is passed horizontally to the left across the back, and the wefts (2) are passed up over it and brought back to the front through the interspaces. In *d*, the warp continues to make longitudinal turns front and back and the wefts to pass over the turns in the interspaces, as in *b* and *c*. The horizontal turns in actual practice are close together and conceal the dyed *puraka* strip (3). After a varying depth, the worker prepares to display some color.

After six complete warp turns have been made (*e*), the dyed *puraka* strip (3) is turned down from the level of the sixth round. The warp continues to make six more complete rounds. As shown in *f*, the *puraka* strip (3) is now turned upward over the last six rounds and stretched flat on the middle strip of pandanus. The warp continues its rounds and the thirteenth round and three subsequent rounds pass over the *puraka* strip and conceal it. The belt maker may now turn down the colored strip and proceed as in *e* so as to expose another section of color.

The above-described warp and weft technique is continued for the length of the belt. As warp and wefts run short, fresh pieces are inserted at the appropriate place between the pandanus strips, as in figure 166, *a*. The colored strip is covered and exposed at regular intervals throughout the belt, the intervals being determined by the worker. At the finishing end, the ends of the warp and wefts are tucked back between the pandanus folds.

Small white cowrie shells are added after the belt is covered by the warp rounds. The method of attachment is modern, for home-made needles of fine wire are used. A number of these needles had been made during the Japanese occupation; and during our visit, Lathrop's fine drill was in constant demand for making holes in the needles. A long two-ply thread is knotted at one end and pierced through a pandanus strip near the intervals occupied by the wefts. The thread is drawn taut to the knot and the needle pushed up under the warp turns on a side piece and close to the weft interval. At a distance of 1 or 1.5 inches, the thread is brought to the surface on the inner side of a weft row. A shell is then attached to the thread by laying the thread along the narrow opening of the shell and plugging it into the cavity with a pith-like material said to have been cast up from the sea, or with the dried core of pandanus fruit. A small stick is used to push the material into the shell cavity. The

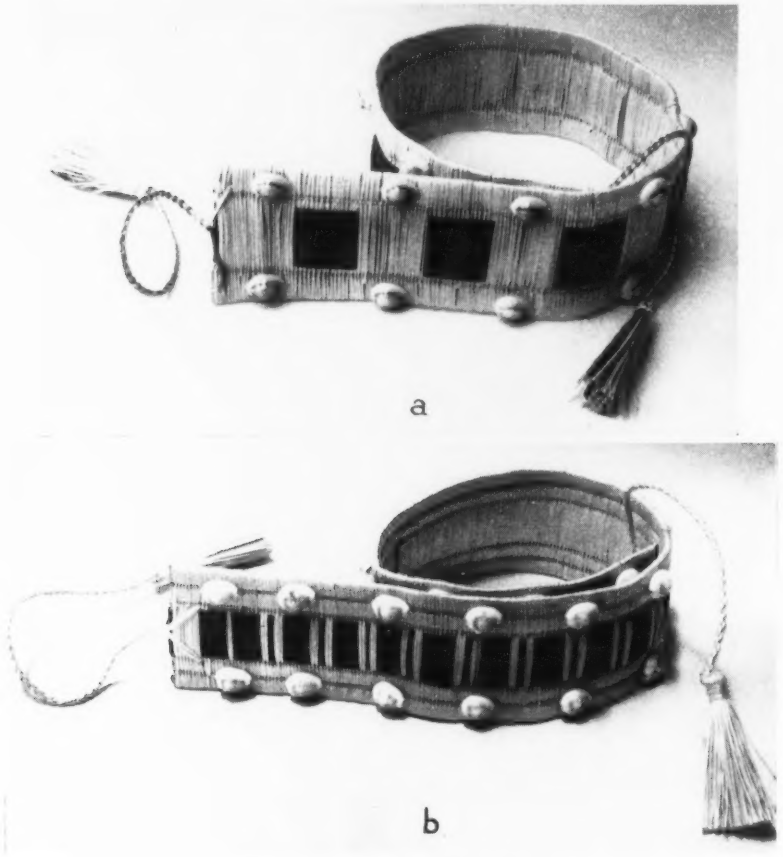

FIGURE 167.—*a*, *b*, trade belts.

process is repeated until a row of shells at regular intervals of 1 to 1.5 inches is laid along the weft line on one side. Then a second row is laid along the other weft row, care being taken to add the shells on the same levels as the first row.

Last of all, strings of the same leaflet material as the warp and wefts are attached to each end of the belt so that they can be tied at the waist. Two strips are pierced through the pandanus leaf foundation on each side of the middle line near the end edge and down through to their middle. The doubled strips form eight strands which are brought together and plaited either in a three-ply braid or a four-ply round cord for a length of about 8 inches. A short bunch of about a dozen strips of prepared coconut leaflet is laid transversely over the unplaited ends of the waist strings, and the strands from the strings are tied around the transverse bunch with an overhand knot. The strips are drawn together in a single bunch below the knot and tied together with one of the strands to form a neat tassel about 2.5 inches long, the ends being cut off evenly (fig. 167, *a*).

Some belts have two narrow side pieces on either side of the middle piece (167, *b*) and thus have four weft rows instead of two, varying the width of the middle piece. Considerable variation occurs in the depth of the sections of color exposed, each worker trying to make his belts more attractive for sale purposes.

HAIR DRESSING

Formerly, the hair (*ngahuru*) was cut with an instrument made of shark teeth (*niha kouru*) set in a wooden handle. The word *kouru* is said to be a shortened form of *hokouru*, which is the plural form of *tokouru*, a species of shark. No specimen of the instrument was procurable.

Women cut their hair short as in Polynesia but the men cut it short on the vertex and left a longer bunch on each side above the ears. This form of masculine hair dressing was termed *ti rau* and our informants, though they no longer use it, instantly recognized it in some of the illustrations in Eilers' work. Eilers (2, p. 119) states that the men used a wooden arrow to dress their hair and that combs (*tui tui*) were said to be in use.

TATTOOING

Though tattooing the body was done in the outlying atolls in Melanesia inhabited by people speaking a Polynesian dialect, the local people maintained that it was never practiced in Kapingamarangi. Eilers (2, p. 118) also says "Tattooing and painting are not practiced."

WEAPONS

The people of Kapingamarangi, probably because of their isolation and small number, did not develop the art of warfare to the extent of manufacturing specialized types of weapons. Eilers (*2*, p. 120) states that the only weapons seen on his visit were the fishing spear and the bow and arrow for shooting at fishes. They cannot be regarded as weapons of war, though the fish spears may have been used offensively on occasions. However, Eilers made mention of spears of sharks' teeth, though he saw none.

It is evident that the people were unarmed over a long period and that they were defeated at times by invaders from other islands. It is curious, therefore, that a highly specialized war dress in the Hamburg Museum should be attributed to Kapingamarangi. Eilers illustrates and describes it (*2*, p. 121, pl. 8) as a jerkin and trousers made in one piece with knotted coconut fiber. To judge from the illustration, the material is thick coir cord worked with a coarse fabric with a netting knot, as in the Gilbert Islands war dresses. In addition to the trousers with long legs and the sleeveless jerkin, there are two rectangular aprons fastened around the waist, one in front and one behind. The technique appears to be different from the coarse netting and is probably coiled work, again like some parts of the Gilbert Islands war dress. It is inconceivable that an apparently peaceful people without weapons should have invented or even manufactured a highly specialized war dress with tailored trousers and jerkin and made aprons with a coiled technique. There must surely be a mistake in the identification, and it seems probable that the specimen in the Hamburg Museum is part of a Gilbert Islands war dress which was left in Kapingamarangi by some Gilbert Islands raiders, or perhaps not even collected in Kapingamarangi.

ACCULTURATION IN MATERIAL CULTURE

In the study of anthropology, more and more attention has been paid to social organization in late years and less and less to material culture. It should be remembered, however, that the material things of life are of primary importance to human beings whether they live on a remote atoll or in a continental city. When the early ancestors of a people arrived on a Pacific island, they were primarily interested in obtaining food and shelter. Though clothing was not such a pressing necessity, they had developed certain views with regard to modesty, and a search had to be made for material to replace their garments as they wore out. The usages with regard to society and religion could well be deferred, but matters concerning food and shelter were immediate needs that had to be dealt with in order to maintain life.

FOOD

If the early settlers brought cultivated food plants with them, their problem of living was eased somewhat. However, the land had to be prepared for cultivation and implements, no matter how crude, had to be made. Even a sharpened stick for a digging tool required some form of adz with which to cut and trim the wood. If they brought adzes with them, their immediate need was met; but these tools had to be replaced as they wore out. If the ancestors brought stone tools, they had to seek a substitute for stone, for none was available in the atoll formation. It took time for newly planted foods to bear a crop, and meanwhile the people had to search for local foods. If the pandanus plant had preceded man to the atoll, its fruit helped to tide him over. The coconut, according to most authorities, was brought to the Pacific islands by man. If the early ancestors brought coconuts with them, it took five to seven years before the planted nut developed into a fruit-supplying tree. A sufficient supply of food could not be obtained from endemic plants, hence the people had to turn from the land to the sea for subsistence.

Shell fish offered an easy supply and crayfish could be caught by hand in the crevices between the coral masses on the outer reef. Fish, however, formed the mainstay in the food problem, though material had to be made with which to catch them. It is a matter for speculation whether the early voyagers carried fishing gear with them on their colonizing expeditions. Certain it is that they must have carried a knowledge of fishing techniques with them from their previous home. That knowledge had to find expression in local material. A search had to be made through the local flora to find plants with the kind of inner bark that could be twisted into cord for lines and nets. The knowledge of making cord must have stretched back into antiquity, but suitable raw material was a recurrent problem. The question of the best marine shells for making hooks required study. A knowledge of self-acting fish traps must have been ancient, but here again suitable material for their manufacture required search, thought, and trial. Thus, the provision of an adequate food supply to maintain life was, as it still is, the primary problem faced by the inhabitants of Pacific islands.

The problem that the transplanted people of Bikini faced on the atoll of Rongerik was not associated with social organization or religion, but with the supply of coconuts and fish. The United States Navy met the difficulties by first giving temporary relief with supplies of food and then solving the real problem by transferring the people to an island where the supply of coconuts and fish was ample for all.

In the course of time, successive generations of Kapingamarangi people adjusted their arts and crafts to make the most of the raw material provided by their atoll home. They learned the respective merits of various plants.

They planted more coconuts and increased their sunken gardens for the cultivation of taro. They learned where to set their nets and fish traps and where to catch various kinds of fish with hook and line. The food problem was well in hand. At some time, the seeded breadfruit was introduced from some other island and, curiously enough, thrived on the atoll soil. It was a wonderful addition, for it enriched the variety and increased the quantity of food and provided material for canoe hulls and cloth. The loom also found its way to Kapingamarangi, enriching the culture and providing women with woven skirts. A later introduction, in historical times, was the *puraka* plant, which, however, caused complications. It grew under the same conditions as the taro and was planted with it in the sunken taro gardens. The *puraka*, a hardy plant which withstands dry seasons better than taro, increased during a succession of dry seasons while the taro decreased. Thus, the *puraka* has almost exterminated the superior taro. However, though the quality of *puraka* is less, the quantity is more and it is used in the same preparations as taro. Thus the balance in the established diet is not disturbed.

The absence of rickets and malnutrition is proof enough that the people have a well-balanced diet which meets all the requirements of health and gives pleasure and satisfaction. The quantity and quality of the native foods are satisfactory for the present generation. Furthermore, an economic balance has been established. Every family can grow and procure its own food without financial cost. Hence, I feel that it would be dangerous at present to introduce foods such as flour, rice, sugar, and canned meat or fish. These are items which commercially minded traders would consider as basic trade goods for which money is required. If the natives acquire a taste for outside foods, there will arise a tendency to neglect the production of their own foods. If flour and rice become popular, the *puraka* cultivations will receive less attention. A taste for canned fish and beef would also detract from the interest and activity connected with fishing. Such changes in the food supply would also involve the question of how the people are to raise money to buy subsistence which they now acquire without money.

HOUSES

There is no housing problem in Kapingamarangi. The people long ago learned the value of local woods for the house framework, the leaves for thatch, and the cord for lashing the parts together. With the exception of a few board houses roofed with rusty corrugated iron and made during the Japanese occupation, the houses are of native style made from native material. Even young adolescents know how to lash the framework together and fasten the thatch. Every adult can build his own house with material obtained from his own share of land in one of the islands. Building a house is a social event

in which the labor is enjoyed as a community effort. The dispensary on Touhou, after the material was contributed by the people, took only half a day to erect and thatch. It did not cost a cent for material or labor. The well-ventilated houses with open walls and thatched roofs are far better suited to a tropical climate than the corrugated iron roofs of plank houses.

There is no sensible reason why the people should be encouraged to change their form of house for ours. Those who desire to buy timber and corrugated iron in order to build an American type of house should be discouraged. The native house has no floor to scrub and no corners to collect dust and dirt. The floor may be refreshed from time to time with a new layer of clean white coral gravel. As sawn timber, corrugated iron, glass windows, special doors, nails, and paint cost money, a change in the type of house would raise an additional economic problem. In other islands where such a change has taken place the people, unable to afford good material, have erected buildings of scraps of board and pieces of tin which are an eyesore and an abomination. It would perhaps be a good thing for native councils to discourage the erection of houses which do not comply with native standards.

CLOTHING

As regards clothing, inevitable changes have occurred. The superiority of trade textiles over native material is as obvious to the natives as the superiority of steel tools over stone implements. Thus like shell adzes, abandoned long ago, the art of making bark cloth will vanish. Weaving with the native loom lingers on as an accomplishment, not a necessity. Foreign cloth has completely replaced native cloth, though it has not entirely replaced the form of clothing. The trade cloth is still worn as a skirt or kilt in native fashion, particularly for working clothes. And for all children, the kilt is still the only form of garment. Trade cloth is even worn as a *maro* (*mara*) by men, during such activities as fishing.

However, the western desire for change in fashions has reached Kapingamarangi. There is the universal desire for something better to wear to Church and to social events. The men have begun to wear shirts and trousers and even coats and shoes to church on Sundays and when a ship comes in. The younger women are becoming self conscious with regard to the exposure of the upper part of the body and are seeking blouses and dresses. The further desire for the extra refinements in clothing is indicated by the fact that among the articles ordered from the trading company are short underpants for men and the feminine equivalent for women. The desire for more clothing material cannot be met except by increasing the production of marketable goods for purchasing.

When the wife of a naval officer visited the atoll during our stay, her pinafore dress aroused the greatest interest among the women folk. They ex-

amined its technique and admired it so much that the owner sent it back from the ship as a gift to the atoll. It is probable at least that some of the 16 sewing machines repaired by Mr. Lathrop are now employed in making local versions of the gift garment. Fortunately, this pattern is more suited to the tropics than the more voluminous Mother Hubbard garment which was introduced into Polynesia over a century ago.

CANOES

Canoes are indispensable items in the economy of Kapingamarangi and ideally suited to the requirements of the people. The acquisition of steel tools has rendered the work of building them easier, and the adoption of the Nukuoro type of construction has also made canoe building simpler as well as more economical in amount of material needed. The people are expert at building their type of craft, and the timber and lashing materials are produced locally. Hence, any attempt to introduce plank boats with oars would entail unnecessary expense for planks, nails, and bolts and result in an unsuitable type of craft. The fairly plentiful supply of breadfruit trees will provide hulls to meet the local demand for some time to come. However, the Kapingamarangi canoes are admired by outsiders, and during our stay three canoes were bought by people living elsewhere. While this is a compliment to local craftsmanship, there is a danger that the export of even a few canoes may upset the local law of supply and demand.

In the canoe building craft, all that is required from without are steel tools and the canvas sails now in use. However, the introduction of a good marine paint would help to prolong the life of the canoes.

FISHING

Fishing still provides the main source of protein food. In the changing process of the years, trade hooks and lines have replaced the native forms, but the methods of fishing remain the same. The various methods of angling, netting, and using traps cover the needs of the people and they have nothing to learn from outside sources. It is hardly likely that commercial fishing by foreign companies will affect the local supplies.

OUTSIDE NEEDS

I have attempted to show in this work that the people of Kapingamarangi have a well-balanced diet with an adequate food supply and that they have an adequate supply of raw material to meet most of their needs. However, in the inevitable acculturation process which has taken place, they do need a number of things which only money can buy. Steel tools and clothing must be replaced, and the smoking of cigarettes has become general, except

among prominent members of the church. Canvas for sails is expensive but it lasts a long time. So far paint has not been used extensively on canoes, but the use is likely to increase. Hooks and lines and cord for nets are also purchased. Extras, such as canned foods, rice, flour, shoes, candy, scent, and other goods excite interest when money is available. Kerosene for lamps has come to be a necessity, as many people plait mats and belts at night or in the early morning. When we had our electric lights or gasoline lamps burning in our hut at night, groups of people sat outside making belts by the light which shone from the veranda or through the windows. The need of the people for trade goods though small, comparatively speaking, exists to the extent that they must produce marketable goods to gain purchasing power.

COMMERCIAL INDUSTRIES

In order to provide the people with funds to purchase what they need, the Navy has encouraged the production of native handcrafts that can be sold at Navy posts. The Island Trading Company, which was established to encourage production, markets the native goods and supplies the required trade goods at reasonable prices. As plaiting is the craft able to produce the most suitable articles for sale, the making of pandanus floor mats has been increased and the pattern of the Marshall Islands belt adopted and improved upon. Except for dyes, materials—pandanus leaf, specially treated coconut leaflets, and *puraka* skin—are all procurable without cost. Head bands, ornamented with shells, add variety to the trade goods, and we suggested the plaiting of small table mats from pandanus leaf. The plaiting of cigarette cases, wrist bands for watches, and holders for glasses is also neatly done in some islands.

Specimens of local cloth would be of interest to purchasers, but a price based on the time and labor in weaving on the hand looms has to be set too high to make the articles marketable. Another avenue open to men is the making of model canoes, and some even make "curios" by shaping Tridacna shell on a grindstone and hafting them as shell adzes for sale. From the various handcraft articles the people derive a fair revenue, but the market is liable to become glutted and the demand to fall off.

The surest source of income in Kapingamarangi, as in other atolls, is copra. Encouragement to increase the supply of copra, however, requires a certain amount of caution and study. The number of green and mature nuts used by a family for drinking and food preparations in one year must be very large. The coconut is combined with taro, *puraka*, and breadfruit in so many food preparations that it is probably the most important single item in the diet balance of an atoll people. Nothing should be done to disturb this balance. Thus, the quantity of coconuts necessary for food should come first

and only the surplus be converted into copra. Hence, the quantity of copra produced is likely to vary with different families according to their land holdings and the number of coconut trees upon them. If a family with small holdings were encouraged to produce more copra, they might encroach on the quantity required to maintain their established balance in diet. It does not seem right to increase the purchasing power for foreign goods at the cost of disrupting the diet balance that generations of people have perfected through practical experience. A scientific inquiry into the number of coconuts used per individual per annum for food and the quantity produced on land holdings would throw some light on what should be devoted to copra.

Another problem may be created by an unrestrained increase in the output of copra. At present the people are cooperative. They have enough land to supply their creature wants. Land beyond their present needs now means only a certain amount of social satisfaction, and they readily share extra coconuts with those not so well off. Once the increased supply of coconuts becomes valuable, however, people may become individualistic and selfish. The more commercially minded individuals might well use influence or position to acquire more land in order to increase their wealth. Emory, after his study of the local land tenure, feels that there are already indications of the desire to acquire more land for commercial purposes. In larger land areas, such an attitude might be regarded as commendable, but on an atoll with its small area, it is dangerous to allow a departure from the established distribution. No doubt, the output of copra on Kapingamarangi can be safely increased to the advantage of the people, but a certain amount of caution and study should precede such an increase.

CONCLUSION

Problems affecting the native inhabitants of the Pacific area vary in the different islands. It is not wise to attempt to apply the same routine methods of procedure to all. The people of Kapingamarangi are an atoll people who have developed a balance between their culture and their geographical background in which they intend to continue living. Their land, though not isolated in this era of frequent ocean transport, is remote from the disturbing influences of more populous communities. Beyond a simple system of education in English, which they earnestly desire, some medical attention which they are now receiving from the Navy Medical Service, and a few trade objects now supplied by the Islands Trading Company under the Navy, they have nothing to gain from the outside world. They are self-supporting, healthy, and happy. They have created their adjustment with life from within and every effort should be directed toward avoiding any undue disturbance of that balance by influences from without.

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